

A RAND NOTE

INSTITUTIONAL ISSUES IN THE PLANNING AND
IMPLEMENTATION OF A PROGRAM TO DISPOSE OF
HIGH-LEVEL RADIOACTIVE WASTES

Jackie L. Burns

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PREFACE

The research reported here was initiated in January 1980 and performed for the Office of Policy and Evaluation, U.S. Department of Energy. The study arises from recognition by the DOE that the resolution of institutional issues is vital to the establishment of facilities to dispose of high-level radioactive waste (HLW). The disposal of HLW is an intensely difficult public policy problem. The DOE must develop and implement complex physical and engineering systems in the face of dispersed intra- and intergovernmental authorities, highly asymmetric risk/benefit distributions, and emotion surrounding potential radiation hazards. The requirements for implementing a program with complex institutional relationships where there are no clear lines between technical judgments, political judgments, and institutional arrangements are not well understood.

The purpose of the research reported here is (a) to determine the nature of institutional issues facing the HLW disposal program, (b) to identify actions needed to resolve these issues, (c) to describe and evaluate the implications for program design and implementation, and (d) to help assess the capabilities of the current program for implementing a repository program.

The research involved a review of DOE and contractor program documentation; program documentation from other agencies; articles, meeting reports, and transcripts on nuclear waste management; and other siting literature. The aim was to identify the institutional and other "actors," their responsibilities, and points of controversy between DOE

and other actors. Personal notes and observations of the author gathered from several years of structuring, participating in, and observing meetings to identify and assess policy and institutional issues in nuclear waste management supplemented the literature review. Literature on implementation, organizational behavior, and business administration was used to evaluate and describe the implications for program design. The program documentation and interviews with DOE management officials were used to assess current capabilities of the DOE HLW program for undertaking the activities necessary for implementation.

This Note is intended to provide guidance to the DOE policy office on improved means of planning and implementing a program to develop HLW repositories. The evaluation of the institutional framework facing the Department and the paths of actions needed to implement the program--found in Section II and Appendixes A and B--should be useful to the DOE line manager responsible for program components important to waste disposal. The Note should also be of interest to individuals, agencies, states, and other organizations participating in the establishment of nuclear waste facilities.

SUMMARY

The Department of Energy (DOE) is responsible for the siting, development, and operation of facilities to dispose of high level radioactive waste (HLW). This is an impressively difficult and complex task which involves research and development on geologic disposal technologies as well as nationwide transport of wastes, site characterization and selection, land acquisition, setting fee schedules, securing license approval, gaining concurrence from one or more potential host states, and numerous other implementing steps. The current responsibilities of the DOE for HLW disposal are a sharp departure from the historic responsibilities for and experience in research and development and management of existing defense HLW.

The research reported in this Note was conducted

1. To determine the nature of institutional issues facing the HLW disposal program.
2. To identify actions needed to resolve these issues.
3. To evaluate and describe the implications for program design and implementation.
4. To help assess the capabilities of the current program to implement a repository program.

We find that the sharing of authority among DOE and other actors--many program implementing decisions and activities can only be made with the participation or approval of important non-DOE actors--drives the consideration of institutional arrangements in implementing an HLW

disposal program. On its own, the frequency of shared decision points would create difficult problems of coordination. DOE's task is made more difficult because implementation of the program will impose costs and confer benefits on these other actors (or those they represent), and the magnitude and specifics of these potential costs and benefits are uncertain. As a result, the mechanisms for resolving conflict between the DOE and other important interests, and the decisionmaking process itself are of great importance to the successful development and operation of an HLW repository.

Section II and the materials contained in the appendixes illustrate the complexity and nature of the implementing tasks facing DOE program managers. Actions necessary for implementation were identified by examining the distribution of responsibility and authority to implement the HLW program among the DOE and non-DOE actors (e.g., other federal agencies, the states, localities, and public and private interest groups) and the conflicts between the DOE and these other actors. Using a technique of backward mapping, paths of actions needed to resolve these conflicts and to implement the program were developed. The siting component is evaluated in Section II to illustrate the methodology.

The constraints on DOE's authority resulting from the power of other actors to influence the HLW program, combined with an environment that is continually changing, imply the need for a form of dynamic planning and program implementation that we term strategic management. This management style permits the DOE to set and modify program objectives in light of the overall goals of the program and the changing

interests and powers of influence of non-DOE actors. It requires three fundamental classes of activity:

1. Gathering information concerning the external environment within which DOE must operate (the actors, their interests and stakes, their manner of bargaining, and likely bargaining objectives), as well as estimates of likely changes in that environment.
2. Strategic planning, which formulates objectives and delineates alternative actions for the program in light of its overall goals and the information that is gathered about other interests involved.
3. Bargaining and negotiation to reach accommodations with these outside actors that further program goals.

These are continuing activities. Strategic planning must respond to the input of new information concerning the environment in which the HLW program operates as well as the needs of the negotiators. The negotiations themselves will provide information that will lead to revised plans.

The DOE HLW disposal program, in its current form, is likely to have difficulties with strategic management. We judged the strengths and weaknesses of the current HLW program to implement the siting component according to the following criteria:

- Statutory authority--Is it present or absent?
- Assigned responsibility--Is responsibility for an implementing task clearly assigned to a DOE management official? If the activity is a negotiation or operational activity, has

requisite strategic planning been clearly assigned or is the negotiation carried out in a case specific manner without policy guidance?

- Is the DOE relying on contractor staff or in-house capability to conceptualize and initiate strategic and other planning tasks?

We conclude that:

1. Current statutory authority might not provide DOE the range of alternatives necessary to satisfy the concerns of potential host communities in a fashion sufficient to permit siting.
2. While assignment of responsibility to conduct operational activities is clear, responsibilities have not been fully assigned to assure that necessary strategic planning and negotiation are performed. Moreover, in many cases, responsibility to engage in negotiation or operational activities is assigned and carried out in a case-by-case fashion without the benefit of policy guidance. More explicit attention to monitoring the environment and to strategic planning would enhance the ability of the DOE to anticipate controversy, to identify a range of alternatives that will satisfy the important interests of other actors, and to conduct and implement negotiations.
3. DOE has often relied on contractor personnel to identify and analyze institutional and socioeconomic issues and to conceptualize or initiate responsive action. Such delegation

places the contractor in a position to set policy precedents.

This responsibility rests more appropriately with public officials.

4. DOE staff needs expansion and upgrading to deal effectively with these institutional issues. This is not to denigrate existing staff who generally are performing well the tasks assigned to them. Our review, however, suggests that higher priority should be given to strategic planning and conflict resolution, activities that will require a different skills mix from technical analysis and operations.

We recognize that in many ways the concept of strategic management is incompatible with the manner in which we run our government. Government organizations are frequently limited in the degree to which the qualities necessary for strategic management can be achieved. Despite strong commitment, it is extraordinarily difficult to make things happen in the face of all the checks and balances that are a part of the public sector. Maintaining a faith within a staff that an organizational unit four levels down in a frequently beleaguered Department is able to create its own future may be beyond the capacity of even the most skilled public servant.

The fact that strategic management may be difficult to achieve in a public bureaucracy does not lessen its importance to the success of the HLW program. DOE faces a real quandary. We recommend that DOE carry out a major study of the needed changes in the HLW program. Section V suggests some issues of importance, and this Note provides a starting point for some elements of the study.

ACKNOWLEDGMENTS

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The author bears full responsibility, of course, for any remaining factual errors and for interpretation of the complex system discussed herein.

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I. INTRODUCTION

The federal government has assumed responsibility for the safe disposal of high level radioactive wastes (HLW)[1] and has entrusted statutory authority and lead responsibility to the Department of Energy (DOE).[2] In this capacity DOE is ultimately responsible for siting, developing and operating repositories for disposal of HLW.[3]

This study arises from the recognition by the DOE that the resolution of institutional issues--conflict between the interests of other actors and the DOE--is vital to the establishment of facilities to dispose of HLW. The disposal of HLW is an intensely difficult public policy problem. The HLW program must develop and implement complex physical and engineering systems in the face of disperse intra- and intergovernmental authorities, highly disjoint risk/benefit

[1] High level radioactive wastes, for purposes of this report, include spent reactor fuel (if disposed of), and the wastes that result from reprocessing of spent fuel. The formal definition found in the laws and regulations of the federal government defines liquid high level waste as "those aqueous wastes resulting from the operation of the first cycle solvent extraction system, or equivalent, and the concentrated wastes from subsequent extraction cycles, or equivalent, in a facility for reprocessing irradiated reactor fuel." 10CFR50, Appendix F, and the Marine Protection, Research and Sanctuaries Act of 1972, P.L. 92-532.

[2] Federal assumption of responsibility is reflected in Administrative agency budget authorizations and appropriations; the Final Report of the Interagency Review Group on Nuclear Waste Management, TID-29442, March 1979; the Energy Reorganization Act of 1974, as amended (P.L. 93-438); and Title 10, Code of Federal Regulations, Part 50, Appendix F.

[3] The disposal option favored by the Administration and the majority of the interested scientific community is emplacement of HLW in mined geologic repositories. Administration policy calls for earliest operation of a first repository in the mid-1990's. For purposes of this study, an operating HLW repository means a repository (whether full-scale, pilot, or research and development) receiving and emplacing wastes at the rate projected in design and licensing specifications.

distributions, and emotion surrounding potential radiation hazards. The requirements for implementing a program with complex institutional relationships where there are no clear lines between technical judgments, political judgments, and institutional arrangements are not well understood.

The purpose of the research reported here is

1. to determine the nature of institutional issues facing the HLW disposal program;
2. to identify actions needed to resolve these issues;
3. to evaluate and describe the implications for program design and implementation; and
4. to help assess the capabilities of the current program to implement a repository program. For this study, we assume that the technology for safe disposal of HLW is available or will be available on the time schedule projected by DOE.

DOE HLW PROGRAM EVOLUTION

U.S. management of defense and commercial nuclear HLW has evolved in an incremental manner over the last three and one-half decades. Beginning with a rapid mobilization during World War II and for the next 20-25 years, wastes resulting from the defense program were thought of as residual materials requiring care, but whose care was considered peripheral to the urgent need for nuclear weapons and nuclear-powered ships. HLW was stored in tanks (and remains stored) at the three DOE facilities that produce plutonium or reprocess spent fuel--the Hanford Plant in Washington, the Savannah River Plant in South Carolina, and the

Idaho National Engineering Laboratory. Somewhat disparate management techniques arose between the facilities as a result of Atomic Energy Commission (AEC) policies which viewed waste management as a local cleanup operation not requiring an integrated headquarters effort.[4] Notwithstanding operational problems,[5] plans during the 1960s for commercial management of HLW from reprocessing at the Nuclear Fuel Services plant at West Valley, New York, paralleled the technology used at Hanford and Savannah River with some improvements in tank design and construction.

The basic conceptual framework for the disposal of HLW emerged from a report by the National Academy of Sciences in 1957. The NAS noted that "the most promising method of disposal of high-level waste at the present time seems to be in salt deposits." By the late 1960s and early 1970s, waste disposal in salt formations began receiving serious political and technical attention.

The federal program for HLW disposal has undergone several major programmatic changes during the last decade. At the beginning of the 1970s the AEC was confident that repositories could be sited and constructed in bedded salt with relative ease. The AEC program was a development and demonstration program. By 1972, programs for developing bedded salt repositories gave way to a concept called retrievable surface storage facilities (RSSF), which in turn was abandoned in 1974 in favor, once again, of bedded salt repositories. Presidents Ford and Carter, in 1976 and 1977 respectively, supported ERDA programs designed

[4] Harvey J. Spiro, Investigation of Selected Hypotheses in Early Radioactive Waste Management Policy, September 1979.

[5] The tanks suffered loss of integrity sooner than expected.

to establish at least one repository in salt by 1985. On February 12, 1980, President Carter announced the nation's "first comprehensive" waste management program and formally expanded the repository program to investigation of non-salt geologic media, the qualification of several sites prior to selection of the first site, and the mid-1990s as the earliest time for operation. The President also recognized the role that state and local governments play in HLW disposal by adopting the principle of federal "consultation and concurrence" with states and by creation of the State Planning Council composed of 18 elected state officials and four federal officials.

The current organization is assigned broad responsibilities ranging from research and development on geologic disposal technologies to nationwide transport of wastes, siting, land acquisition, setting fee schedules, securing license approval, and gaining concurrence from one or more potential host states. In response, there is now a Deputy Assistant Secretary for Nuclear Waste Management and an organization devoted entirely to establishing means for the safe handling and disposal of radioactive wastes.

Thus, the responsibilities of the DOE for HLW disposal represent a sharp departure from the historic (AEC) responsibilities for and experience in research and development and management of existing HLW.

DEFINITIONS

Although there is a growing consensus that institutional issues are important to repository development, the term "institutional" carries

different connotations. For purposes of this study, we employ the following definitions.

Institutional Arrangements

Institutional arrangements refer to the structure of political, administrative, economic, legal, social-economic, organizational, level of risk acceptance and other non-technological procedures and factors which are involved in putting HLW disposal technology into place.

Authority

Authority is the power to influence the actions of others. Authority can be formal, legal responsibility or can be practical influence not based on formal delegations of authority. For example, the DOE has been assigned lead federal responsibility for the siting, development and operation of HLW repositories. The Nuclear Regulatory Commission (NRC) has been delegated federal authority for licensing and regulating repositories to protect public health and safety. The state governments have no formal authority for assuring safe HLW disposal but can exercise political influence to affect the manner of disposal.

Actors

Actors are those organizations or individuals who can exercise authority (formal or practical) over HLW disposal. Organizations become actors in HLW disposal because they have legal responsibility which makes them concerned with the manner of disposal or because their interests (economic, political, legal, and sense of well-being) are influenced by the institutional arrangements for disposal of HLW.

Actors with formal delegated authority can be identified by examining the federal laws and regulations which control HLW disposal. Actors with informal authority who have already expressed an interest in HLW disposal include local and state governments, private citizens, elements of the business sector, and environmental interest groups. A potential host community is concerned with potential exposure to radiation, orderly and planned community growth, relative prestige with neighboring communities, and economic development. A state government is concerned with many of the same things but has a wider "community" of interest and the individual interests of segments of that wider community must be balanced against one another. A state governor, in addition to the above, is also concerned with maintaining a coalition of supporters. The state governors as a group are interested in protecting "state's rights"--maintaining or increasing the influence of the state in the activities of the federal government within the state boundaries. Some local citizens might be interested in preserving an undeveloped area for scenic, recreation, or wilderness values while other local citizens might be interested in designating the same land for industrial development. In the private sector, a trucking company might be interested in expanding its business (establishing a capability and clientele for transport of waste) while protecting its current operations. National environmental organizations are interested in establishing the procedural requirement for certain forms of public participation in siting of energy facilities and in assuring that environmental impacts are minimized.

The interests of these actors are directly affected--they are made better or worse off--according to the institutional arrangements proposed and implemented by the DOE in developing HLW repositories. We assume: (1) When implementation of the program confers benefits, actors will support (actively or passively) the DOE program; and when it imposes costs, they will oppose the DOE program. (2) The amount of time and effort that an actor will spend to oppose (support) the DOE program will depend upon the magnitude of expected loss (gain).

Institutional Framework

The institutional framework facing the DOE is the set of actors, their authorities, their stakes or interest in HLW disposal and their manner of opposition or support. For this study, we evaluated, at a high level of abstraction:

- who the actors are,
- their responsibility,
- the status of exercise of responsibility or authority, and
- the points of controversy that arise between the interests of other actors and the actions or interests of the DOE.

OUTLINE OF THE REPORT

The policy questions addressed by this study include: the specific nature of the institutional framework facing the DOE program, the actions important for implementation, the implications for program planning and implementation, and the strengths and weaknesses of the DOE in planning and implementing an HLW disposal program.

Section II illustrates how the institutional framework for siting of a repository is evaluated and establishes a path of actions needed for implementing the siting component. We first identify the responsibilities and authority of the DOE and non-DOE actors, and the points of controversy between them. Through a process of backward mapping, we identify the actions that DOE and other organizations would have to take to overcome institutional constraints to siting an HLW repository. The product is a flow chart of actions required to be taken for the successful siting of an HLW repository. We highlight those actions which (a) depend upon action by another federal agency, (b) involve authority shared with a non-federal entity, or (c) require Congressional approval other than approval of ongoing research and development activities. This procedure is repeated for other components of an HLW disposal system (see Appendixes A and B).

Continuing to use the area of siting for illustration, Section III addresses what the institutional environment implies for program implementation. The ability of other actors to influence the DOE program, combined with the number and nature of potential conflicts with those actors, implies the need for strategic management. Strategic management is a management style which permits the program management to set and modify program objectives in light of the program's overall goals and non-DOE actors' interests and power to influence. The term is used to focus on the interdependence of the decisions of the DOE and the non-DOE actors in HLW disposal and on the expectations about each other's behavior.

Section IV assesses the adequacy of statutory authority, organizational and staffing capabilities of the current DOE HLW disposal program. Section V pulls together the findings of the study important to policy.

Two appendixes are provided. Appendix A applies the analytic approach of Section II to the area of HLW transportation. Appendix B evaluates the institutional framework for program components other than siting and transportation and develops preliminary paths of actions needed for program implementation. These appendixes plus the siting analysis contained in Section II are important products of the study which can be used as the basis for more intensive planning by DOE.

II. INSTITUTIONAL FACTORS IN THE IMPLEMENTATION OF AN HLW DISPOSAL PROGRAM

Program design and the organizational capabilities required to bring about specific policy or operational decisions are elements of implementation within the control of DOE. The effectiveness of alternative program designs is determined by the constraints imposed from outside the Department. Countless program permutations can theoretically lead to an operating HLW repository. The specific decisions made and importantly the process by which decisions are reached will determine whether or not DOE reaches its stated goal. This section illustrates the interaction of one program component, siting, with the institutional environment facing the DOE.

ASSUMPTIONS REGARDING THE INSTITUTIONAL FRAMEWORK

The study is based on the following premises about the institutional framework:

1. The DOE has lead responsibility to implement a program to establish an HLW repository. Other federal agencies will be concerned with the manner of disposal but no other entity has responsibility (can/will be held accountable) to build and operate a repository. The diffuse federal responsibilities help to assure consideration of diverse viewpoints and broaden the expertise and experience brought to bear by the federal government, but at the same time they make implementation of a disposal system more complex.

2. The assignment of responsibility to the DOE does not carry with it the unilateral authority to implement the program. Many individuals or organizations inside and outside the federal government can directly influence the exercise of DOE HLW responsibilities. The DOE must share authority with a variety of federal and nonfederal actors who have policy mandates or interests different from DOE and who will seek involvement in program implementation because of their delegated responsibilities or because their interests are affected by an HLW disposal system.
3. The process by which the DOE HLW program reaches scientific judgments will be scrutinized by other actors.
4. The distribution of potential risk is disjoint; this significantly influences the perceptions of those who feel at risk and raises issues of health, well-being, and equity.
5. Issues involving potential radiation hazards are matters of scientific controversy and generate public concern and emotion.

DOE Is Assigned Lead Responsibility

Pursuant to Section 203(a) of the Department of Energy Organization Act (P.L. 95-91), DOE is assigned responsibility for the establishment of facilities, programs, and fee schedules to recapture costs for the disposal of HLW. President Carter's statement of February 12, 1980, established DOE as the lead federal agency for the management and disposal of high-level radioactive wastes.

The responsibilities assigned to DOE are extremely broad, and are more extensive than those traditionally given to the DOE HLW program (or the programs of predecessor agencies). One of the largest resource-consuming tasks (both in terms of budget and manpower) in HLW disposal is R&D on geologic disposal technologies and on waste solidification and packaging technologies. In addition to R&D, the program is charged with siting a controversial facility, assuring nationwide transport of radioactive wastes, acquiring private land or withdrawing public land from alternative uses, setting equitable fee schedules and arranging financing, securing license approval from the NRC, hiring and training personnel, coordinating the activities of several federal agencies, and gaining concurrence from one or more potential host states. The DOE is not frequently in the business of developing, siting, building and operating controversial facilities which have major private and intergovernmental interfaces.[1] The DOE (and its predecessor agencies) have broad experience in conducting research and development programs. There is less experience in the transition from R&D to commercialization. Operational experience is limited primarily to large installations sited during a different era and developed for defense activities.

[1] Such controversial facilities include, among others, electric generating plants, prisons, sewage and waste treatment plants, and LNG terminals. The siting experience of these commercial enterprises might provide useful lessons for development of HLW repositories.

Leverage Over the DOE Program Exists Outside DOE

Many individuals and organizations inside and outside the federal government can directly affect the exercise of DOE HLW responsibilities. DOE is faced with a complex web of federal regulatory requirements and responsibilities. Pursuant to the Energy Reorganization Act of 1974, the Atomic Energy Commission was split into the Nuclear Regulatory Commission (NRC) and the Energy Research and Development Administration (ERDA--now subsumed within DOE). Whereas the AEC's operations including management of defense HLW were self-regulated, Section 202 of the Act gives NRC responsibility to regulate and license DOE HLW repositories to protect public health and safety. This presents a difficult regulatory environment because (a) the NRC is faced with developing regulations for a first-of-a-kind facility, and (b) the NRC (previously the regulatory arm of AEC) had no prior responsibility and therefore no experience, expertise, or procedures for HLW regulation. The NRC approved final procedural regulations on January 27, 1981 and published an advance notice of rulemaking for technical criteria on May 15, 1980. The NRC technical regulations are not final and large portions are controversial. Thus DOE must plan in the face of uncertainty regarding technical criteria.

The Environmental Protection Agency (EPA) is responsible for establishing generally applicable environmental radiation protection standards for areas outside the boundaries of nuclear facilities, but no standards or criteria for HLW repositories have been developed. EPA has no authority to enforce radiologic standards once developed; NRC regulations must assure that a repository operates within EPA

guidelines. Consequently, both DOE and NRC lack regulatory building blocks for their programs.

Land acquisition, site investigation, technology development, and other activities must be conducted in cooperation with other federal agencies, including the Department of Transportation, the Department of Interior, the Interstate Commerce Commission, and the United States Geological Survey. Additional oversight responsibilities are assigned to other agencies, including review by the Council on Environmental Quality (CEQ) and the EPA of compliance with National Environmental Policy Act (NEPA) requirements.

The federal assumption of complete responsibility for HLW disposal runs counter to the normal distribution of responsibility in the American federalist system--the distribution of responsibility and authority among the federal, state, and local governments. Traditionally, states and localities administer national programs and protect public health and safety. According to Morton Grodzins[2],

Many causes contribute to dispersed power in the federal system. One is the simple historical fact that the states existed before the nation. A second is in the form of creed, the traditional opinion of Americans that expresses distrust of centralized power and places great value in the strength and vitality of local units of government. Another is pride in locality and state, nurtured by the nation's size and by variations of regional and state history. Still a fourth cause of decentralization is the sheer wealth of the nation. It allows all groups, including state and local governments, to partake of the central government's largesse, supplies room for experimentation and even waste, and makes unnecessary the tight organization of political power that must follow when the support of one program necessarily means the deprivation of another.

[2] Martin Grodzins, "The Federal System," Goals for Americans, Prentice-Hall, Inc., Englewood Cliffs, N. J., 1960, p. 271.

We can verify by observation that most social objectives of national programs are administered by states and localities operating with at least partial federal financial support. Such diverse programs as pollution control, secondary education, medicaid, and flood control are largely administered by state and local governments according to arrangements prescribed, in part, in federal legislation and regulation.

The desire by states to continue the traditional sharing of authority and responsibility is reflected in the proposal of the National Governors' Association, which was partially adopted by the Interagency Review Group for Nuclear Waste Management (IRG) and by President Carter for "consultation and concurrence" in the siting of an HLW repository. The formal role of states and localities in the establishment of programs for disposal of radioactive wastes continues to be debated by the Congress and by the State Planning Council on Radioactive Waste Management established by executive order on February 12, 1980.

Importantly, the development of an HLW repository by DOE is perceived to impinge on established state and local governmental functions. This provides further impetus to wrest some measure of control from the federal government. Some of these functions include land use control, highway operation and maintenance, emergency preparedness and response, and protection of the local public health and safety and the environment. Even if the federal government complied with all state and local processes, it could still encounter opposition on the more general grounds of trespass of local autonomy.[3]

Additional functions necessary to the operation of an HLW repository already require the approval or other positive action by non-federal entities, including approval of access roads and rail spurs over non-federal land, provision of construction personnel and equipment, permits under the clean air and clean water acts, and rail transport of material.

Some functions important to transportation must be carried out by the private sector, particularly by the transportation industry. Traditionally, shippers and carriers develop and own transportation hardware--vehicles, casks, packaging, etc. Since DOE has the option to act as both shipper and carrier for HLW, the DOE is potentially in competition with segments of industry.

The greater the number of construction, delivery, and operational components which are handled directly by DOE, the greater becomes the potential for competition with the private sector. The government is likely to be at a competitive advantage because of the opportunities for subsidies or low interest financing arrangements. When DOE becomes a competitor, it is also, potentially, an adversary. In cases, then, where the interests of segments of industry are affected by an HLW disposal system, they will become actors in the implementation of the program.

[3] Randall F. Smith, Federal-State Relationships in Nuclear Waste Management, Draft, B-HARC-311-027, Battelle Human Affairs Research Centers, Seattle, Washington, 1979.

Importance of Process

The process by which the DOE HLW program reaches scientific judgments will be scrutinized by other actors. Because of the long time horizon of potential hazard, HLW disposal technology cannot be fully demonstrated. Consequently, some level of uncertainty exists and the decisions to be made by DOE will necessarily be based on scientific judgments. Yet we have already assumed that the DOE must share responsibility with other actors, and therefore, the judgments will be evaluated by other actors. Those outside DOE who can redirect or impede the DOE program and who do not share DOE's technical expertise must gain confidence in the DOE judgments based solely on the process used to reach those judgments. We consider this an important influence on the institutional framework because the current DOE program faces an environment of distrust and lack of credibility. The program history will make it difficult for the DOE to garner trust in its decision process and support for its judgments.[4]

Although technical judgments are a part of all engineering and scientific application, most technologies can be tested prior to commercial deployment. Learning from error is the norm. Yet the goal of permanent irretrievable disposal over the long term plus the fear of radionuclide release makes HLW repository failure publicly unacceptable. In other instances where demonstration is not possible (e.g., nuclear

[4] We take the "credibility problem" as a given in this study. There are numerous accounts in the literature to support the premise we employ (see Bibliography). This study establishes the need to condition DOE's actions on the actions, expectations, and attitudes of other players. It is, therefore, important that DOE correctly assess the level of trust by non-DOE actors in the DOE judgment and decision processes.

weapon system deployment or manned space flight), the projects' designs are subject to little public scrutiny.

Disjoint Distribution of Risk

Disposal of HLW results in an asymmetric distribution of potential risk. Risk is disjoint geographically and across generations. Because most nuclear reactors are located geographically distant from areas being considered as potential repository sites, those who potentially are at risk from waste disposal (the host community) might not be the ones who benefit from electricity generated by nuclear power.[5] Further, those at risk from waste disposal are a small subset of the U.S. population who benefit uniformly from nuclear defense capabilities.

This distribution raises issues of well-being and equity among residents of potential host communities. Individuals who would accept a certain level of risk if the risk is spread evenly over all those who benefit from an activity, are often not willing to accept a disproportionate share. Further, individuals are not usually willing to accept risk unless they believe the benefits of an activity outweigh the risk.

Even more difficult to resolve is risk distributed asymmetrically across generations. Since the repository must isolate the HLW from the biosphere for tens of thousands of years, accidental release of

[5] DOE has clearly recognized this controversy as evidenced by their commitment to the principle of regional siting of repositories. See DOE/NE-007, Supp. 1, Cross-Statement of the United States Department of Energy in the Matter of Proposed Rulemaking on the Storage and Disposal of Nuclear Waste, before the NRC, PR-50,51, Sept. 5, 1980, p. II 59-61.

radioactivity might expose individuals many generations removed from those who benefitted at the time of emplacement.

Radiation Hazards Generate Controversy

Issues involving potential radiation hazards are matters of scientific controversy and, importantly, generate public concern and emotion. Many consider even low levels of radiation an unacceptable risk. No one wants HLW in his "backyard." Public concern and stakes are considered quite high as demonstrated by the public opposition dating back a decade to repository development,[6] by the proliferation of state legislation and ballot questions relating to radioactive waste disposal and transportation,[7] and by the scope of and attention received by the nuclear waste management bills introduced into the 96th Congress.[8]

GENERAL STRUCTURE

A program to dispose of HLW encompasses the following system components:

[6] Repository development or siting efforts in Kansas, Michigan, and New Mexico have been successfully halted or modified.

[7] A readout from the Oak Ridge National Laboratory Data File listed 217 statutes introduced or enacted by states relating to nuclear waste management as of June 1979. The NRC and Sandia Laboratories feel the need for similar data files.

[8] For example, the February 1980 issue of Nuclear News (Vol. 23, No. 2) discusses seven separate waste management bills or amendments then receiving active consideration by the 96th Congress and which would have significantly affected the direction of the federal effort or jurisdiction and responsibilities of players.

1. Siting--the evaluation of suitable geologic media, identification of potential host geologic regions, site, characterization, site selection, and land acquisition.
2. Facility design and construction--including considerations of waste retrievability and repository decommissioning and closure.
3. Waste Package--the research for and development of suitable waste forms and overpackaging, the development of pilot and full scale waste treatment and packaging facilities and the operation of those facilities.
4. Radiologic Monitoring--the assessment of monitoring needs and state-of-the-art capabilities, considering the unusual technical requirements for long-term repository integrity and the development of technical monitoring capabilities.
5. Financing--both financial arrangements (including fee schedules) and liability or financial protection programs.
6. Transportation--a system to move wastes from reactors, away-from-reactor spent fuel storage facilities, and/or federal research and development and defense storage facilities in accordance with approved routing, equipment and operational procedures.
7. Operation/Administration/Personnel--mechanisms and procedures for hiring and training of personnel; monitoring; accident prevention, detection and corrective action; physical security; material control and accountability; land management; and emergency response.

These system components, which are not totally distinct, lend a structure for considering institutional factors in repository program development.

For each of the seven components, the institutional framework was evaluated. The elements of the framework include (1) the actors,[9] (2) their responsibilities, (3) the status of exercise of responsibility and (4) the potential points of controversy where the interests of DOE and these actors are in conflict. The elements of the institutional framework were identified through a review of: DOE program documents; articles, meeting reports and transcripts on nuclear waste management; and other siting literature. Personal notes and observations of the author gathered from participation in meetings on waste management over a period of several years were also used.[10] The framework should be viewed as a first cut at identification.

[9] As defined earlier, an actor is any organization or individual which has the legal or political capability (responsibility or authority) to affect the course of the DOE program. Local governments, local citizen groups, and environmental or other public-interest intervenors were not included in this analysis. These actors have leverage which can be applied through a variety of means including traditional existing legal and administrative channels although they are not restricted to those channels. It is particularly important that DOE focus on these groups when extending the planning process described here. They will have particular leverage at the site-specific stage of repository development.

[10] These meetings were usually attended by representatives of state and local governments and private interest groups and were designed to define policy issues and points of conflict and consensus. Among some of the formal meetings were a workshop held by the NRC for state government officials on siting repositories in 1977, small interest-group meetings and sub-group meetings of the Interagency Review Group for Nuclear Waste Management, hearings held by the DOE in New Mexico on the proposed Waste Isolation Pilot Plan in 1978, legislative hearings held by the U.S. Congress and by several state legislatures, and meetings convened by the Keystone Center for Continuing Education.

The actions which DOE and other organizations would be required to take to implement an HLW disposal program were identified. These are called "needed actions." They were identified considering the constraints imposed by the distribution of legal responsibility, procedural requirements, and points of controversy between the DOE and other actors and with the aid of "backward mapping." [11] The technique emphasizes the characteristics of actions rather than their timing. Backward mapping involves stating the final action under consideration, identifying the immediately preceding step required to make the action happen, then working back to the next preceding step, and so forth, until existing arrangements are reached. The process of moving backward from a given step to the one immediately preceding depends on identifying institutional constraints to the action under consideration and specifying actions necessary to overcome the constraints. The constraints are drawn from the points of controversy identified in developing the institutional framework.

This information is arrayed in tables for each system component, entitled "Institutional Framework." The tables include (a) "needed actions" which are responsive to (b) the institutional constraints (points of controversy) and are organized according to (c) the organizational framework of responsibilities and authority. Figure 1 illustrates the table headings and structure.

[11] Richard F. Elmore discusses the process and logic of backward mapping in Complexity and Control: What Legislators and Administrators Can Do About Implementation, Institute of Governmental Research, University of Washington, Seattle, Washington, April 1979, pp. 33-34. He credits the idea to Mark Moore at the Kennedy School of Government, Harvard University.

Figure 1

INSTITUTIONAL FRAMEWORK -- ILLUSTRATION

Actors	Responsibilities	Status of Actions and Decisions	Points of Controversy	Needed Actions
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In order to more clearly indicate the activities that need to be accomplished, the needed actions (which appear in the final column of the tables) are sequenced in the flow chart which evolved from the process of backward mapping. A variety of actions appear. There is a mix of

- regulatory activities
- operational activities
- research and development activities
- planning activities
- policy decisions

Some of the actions may require a year or more and substantial resources to complete. Others, particularly some of the planning activities, may require only a small amount of staff effort to evaluate alternatives, but may require much longer for approval. The Path of Needed Actions for each system component is designed to identify major decision or action points which arise from conflicting interests of actors.

This analysis is at a high level of abstraction. For example, the acts of negotiating with rail carriers to assure the availability of rail service or of reaching consensus with a potential host state on procedures for concurrence actually involve a host of more specific actions. There was no attempt to detail issues to be considered in specific planning tasks or to identify special interests having particular stakes in the program. The action paths developed for this study should be used as the basis for more intensive planning. As initial decisions are made and as further analyses identify additional

actual or potential institutional controversy, the path of actions will need to be modified. Such updating will need to be continued in order to maintain an effective and realistic assessment of the institutional issues.

Given the path of needed actions, we have identified those actions that must be designed to deal with potential institutional obstacles to program implementation. We used three criteria for identification:

- DOE shares authority with another federal agency;
- DOE shares authority with a non-federal actor; or
- Congressional approval is required beyond approval of ongoing R&D.

The dependence of DOE on actions by other federal agencies is well recognized. The Interagency Review Group on Nuclear Waste Management (IRG), the continuing existence of a lower level interagency group and the development of a National Plan are intended to coordinate federal activities. DOE must consider how to guarantee action which is timely and sufficient for program implementation in light of the differing responsibilities and priorities of the other cognizant agencies. For example, if rail carriers return to the position that special trains are needed to transport HLW, the Department of Transportation might be asked to decide whether special trains are required to assure safe transport. DOT is in no way obligated to consider this issue or to do so in a fashion timely to DOE schedules. The priorities of DOT are other than nuclear waste transport. DOE must either establish means to resolve

this conflict directly with rail carriers or find a way to influence DOT priorities.

We have already discussed the importance of shared authority with non-federal actors. Resolution of conflicts with these actors is potentially more difficult than with federal agencies because (a) the actors must be identified, (b) they are not accountable to federal authority (i.e., DOT is accountable to the Administration and Congress and can receive instructions to change agency priorities), (c) the interests and resources of non-federal actors might be hard to identify, and (d) they have a variety of means to influence the DOE program, including legal or administrative channels, local, state, and Federal forums, publicity campaigns, and non-cooperation in providing consultation or needed services.

If Congressional action is required, a ready framework is provided where non-DOE actors can exercise political authority. Moreover, due to the legal inability of the DOE to lobby Congress, DOE interests might be poorly represented relative to other interests. Therefore, DOE should frame legislative proposals after consideration of those who have a stake in the outcome of the legislation and could be expected to support (oppose) the proposals.

INSTITUTIONAL FRAMEWORK FOR REPOSITORY SITING

To illustrate this planning concept, the institutional framework for implementing the siting component is developed in this section.[12] (Siting is again used in Sections III and IV which assess the

[12] The tables describing the institutional framework and the action paths for the other system components are contained in Appendixes A and B.

implications for program design and the DOE capabilities to implement an HLW program.) Siting was selected to illustrate this approach to developing an implementation strategy because of its preeminent position in the DOE program, because it presents significant potential institutional obstacles to repository development, and because siting is an early step in repository development. The DOE and others will have trouble addressing any of the other system components until many of the siting issues are resolved.[13] Finally, siting presents very similar problems for establishment of away-from-reactor spent fuel storage and low level waste disposal, and therefore this analysis can be useful in those areas as well.

Siting refers to the planning tasks, operational activities, and research and development needed to select and approve a site for a geologic repository. Success is measured by obtaining a construction authorization from the NRC and by the absence, resolution, or accommodation of institutional and environmental constraints. The DOE is the primary actor and has established a siting process that entails three major stages:

- (1) site exploration--exploration and characterization studies of geographical and geologic areas in order to identify "preferred sites" for detailed site characterization;

[13] Transportation was chosen for consideration in Appendix A because it also presents major institutional considerations and is a component that must be addressed early because of the long development lead times. Our analysis reveals possibly greater institutional obstacles in this area than in siting. In contrast to siting, transportation involves elements of the private sector who share authority with DOE.

- (2) detailed site characterization--at depth and in-situ testing to obtain sufficient data and information to prepare an application for construction authorization to the NRC; and
- (3) site selection--the first stage of site selection is "banking" which occurs "when the participants in the siting process reach a consensus on the technical, environmental, and institutional adequacy of the site relative to established criteria." [14]

To evaluate an institutional framework for siting, we identified actors who have the ability to influence the DOE siting program. Table 1 lists these actors (or groups of actors) who include the states, the State Planning Council (SPC), and federal agencies such as NRC, DOI, and USGS. The abstract nature of the analysis performed for this report is highlighted by the identification of "states" as a unitary actor, despite the fact that individual states have diverse interests and capabilities. The exclusion of local governments, environmental and non-public sector organized interest groups further accentuates the preliminary nature of this analysis. Table 1 briefly describes the responsibility and current actions of each actor identified. For example, NRC has published proposed procedural rules and an advance notice of rulemaking for technical criteria in support of its responsibility to regulate and license DOE repositories.

A major element in the institutional framework for siting is the identification of points of controversy between the DOE and other actors. The severity of controversy combined with the nature of

[14] DOE/NE-0007, p. III-13. The procedures for and definition of when consensus is reached are undefined.

Table 1

(pg. 1 of 4)

INSTITUTIONAL FRAMEWORKSITING

Actors	Responsibilities	Status of Actions and Decisions	Points of Controversy	Needed Actions
NRC	<ul style="list-style-type: none"> ● Licensing authority <ul style="list-style-type: none"> - site suitability criteria - review of site characterization 	<ul style="list-style-type: none"> ● Regulatory development ongoing ● Proposed procedural rule published ● Advance notice of proposed technical rule published 5-13-80 ● NRC awaiting development of EPA standards ● Developing license review capabilities 	<ul style="list-style-type: none"> ● System v. component performance ● Validity of exclusionary criteria ● Ability to license against criteria ● Cost vs. degree of safety ● What uncertainty must be resolved prior to site approval ● Large sunk commitment of public funds and resulting unwillingness to find site unsuitable 	<ul style="list-style-type: none"> ● Establish exclusionary criteria; establish system v. component performance ● Establish site suitability criteria ● Conduct rulemaking ● Conduct site characterization review(s)
DOE	<ul style="list-style-type: none"> ● Responsible for siting a repository; arranging for transfer of land ownership; instituting and administering land use controls 	<ul style="list-style-type: none"> ● Geologic investigation in salt under way ● Ongoing generic and site specific R&D on basalt, granite, shale and tuff at DOE-owned sites ● In-situ heating tests in salt, granite & basalt ● Identified potential geographic regions for investigation ● Developing site characterization program 	<ul style="list-style-type: none"> ● Number of sites to be characterized and mix of geologic media ● Evaluation of resource potential of site--role in site selection ● Manner of compliance with NRC site characterization review ● Site selection criteria--role of non-technical factors ● Technical and non-technical information required for decision-making ● Role of non-site specific in situ testing 	<ul style="list-style-type: none"> ● Determine technical criteria for selecting areas for characterization ● Determine how natural resource evaluations will be performed and propose non-technical selection criteria ● Determine how sites will be eliminated and compared ● Select geologies for characterization ● Develop geologic analytical models ● Select areas for characterization ● Prepare site characterization report(s) for NRC

Table 1

(pg. 2 of 4)

Actors	Responsibilities	Status of Actions and Decisions	Points of Controversy	Needed Actions
DOE (contd.)		<ul style="list-style-type: none"> ● Radionuclide transport models being developed ● Committed to "consultation and concurrence" ● Established technical peer review capabilities ● Final Site qualification criteria published 	<ul style="list-style-type: none"> ● When site-specific impacts should be evaluated: a) according to NEPA; b) to establish consensus; c) as input to programs for compensation ● Dislocation of costs and benefits of waste disposal--geographic, intergenerational ● Methods for socioeconomic impact assessments ● Suitability of NRC procedural rule ● NEPA implementation <ul style="list-style-type: none"> - how many state-ments - timing - support for assessments - scope of statements 	<ul style="list-style-type: none"> ● Characterize sites ● Identify uncertainties and their importance ● Identify how uncertainties will be resolved ● Perform needed in-situ testing and other R&D ● Evaluate each site characterized: <ul style="list-style-type: none"> - socioeconomic and institutional impacts - site suitability - predicted performance - environmental impacts ● Bank qualified sites ● Compare banked sites ● Develop comprehensive procedures for initial property bracketing and for land acquisition and/or public lands withdrawal ● Select site(s) ● Complete initial property bracketing ● Detailed property acquisition ● Assess ability/authority of states to impact siting
STATES	<ul style="list-style-type: none"> ● "Consultation and concurrence" ● Full participant in licensing proceeding 	<ul style="list-style-type: none"> ● New Mexico began process of negotiating procedures for cooperation; does not by law have concurrence 		<ul style="list-style-type: none"> ● (DOE) Develop the parameters for preferred DOE policy and stages for consultation and concurrence and for technical and financial assistance to the states

Table 1

(pg. 3 of 4)

Actors	Responsibilities	Status of Actions and Decisions	Points of Controversy	Needed Actions
STATES (contd.)		<ul style="list-style-type: none"> • Several states developing legislative or executive review capabilities 	<ul style="list-style-type: none"> • Resources and Expertise for Independent Review • Division of responsibility within a State-- legislative vs. executive • Implementation of "consultation and concurrence"; how concurrence is exercised; meaning of non-concurrence • Nature and ability to compensate states for adverse impacts • Extent and nature of land use controls • Role and participation of local governments • Role and participation of the public • Manner of selecting between banked sites • Role of State Planning Council 	<ul style="list-style-type: none"> • (DOE) Negotiate consultation and concurrence with specific states • (DOE) Legislation establishing State Planning Council • (DOE) Investigate DOE and inter-agency options for compensation and economic incentives to the states • (DOE) Develop DOE preferred policy on compensation and incentives to states • (STATES, DOE) Reach consensus on policy and procedures of compensation • Reach consensus on state specific procedures for consultation and concurrence • Assess site-specific impacts • (STATE) Establish legislative vs. executive interaction with Feds (probably as part of consultation and concurrence) • Reach consensus on site specific programs of compensation, mitigation of impacts and incentives
STATE PLANNING COUNCIL	<ul style="list-style-type: none"> • Advise executive branch 	<ul style="list-style-type: none"> • Established by President 2/80 		<p>-----</p> <ul style="list-style-type: none"> • (SPC, DOE) Reach consensus on consultation and concurrence • (SPC, DOE) Reach consensus on site selection and elimination criteria • (SPC, DOE) Reach consensus on procedures and policies for technical and financial assistance to states

Table 1

(pg. 4 of 4)

Actors	Responsibilities	Status of Actions and Decisions	Points of Controversy	Needed Actions
DOI/USGS	<ul style="list-style-type: none"> • Support geologic investigations 	<ul style="list-style-type: none"> • Ongoing advisory and research programs • MOU with DOE in preparation 	<ul style="list-style-type: none"> • Adequacy of state-of-technology to support decisions • Procedures and/or concurrence of DOE on start-up of area specific geologic characterizations • Feasibility (absence of conflict-of-interest) in advising both NRC and DOE 	<ul style="list-style-type: none"> • (DOE) Assign lead responsibility within DOE for concurrence on USGS geologic characterization activities • (DOE) Reach agreement with USGS on procedures for start up of investigations within a state
DOI/BLM USDA/FS	<ul style="list-style-type: none"> • Responsible for the administration of federal lands 	<ul style="list-style-type: none"> • MOU, in preparation 	<ul style="list-style-type: none"> • Potential conflict of land use priorities e.g. wilderness designations 	
Corps of Engineers		<ul style="list-style-type: none"> • Cooperating with NWTS program in Louisiana re: determinations of land ownership and mineral rights and securing access to private lands 		

influence the actor has over the DOE program determines the intensity of opposition and the frequency and magnitude of institutional obstacles to program implementation. Controversy can arise because non-DOE actors do not agree with the process used to reach a decision (who is involved, how alternatives are chosen, criteria used for choice and so on) or because they do not agree with the judgment itself. Specifically, points of controversy involve:

- (a) differences in technical judgments such as the validity of NRC site exclusionary criteria, the development by NRC of system versus component performance criteria and the mix of geologic media to be investigated prior to site selection;
- (b) differences in notions of correct process such as the manner of selecting among banked sites, the timing of community and environmental impact identification and the scope of NEPA evaluations;
- (c) economic/safety tradeoffs such as the extent and nature of land use controls and the system capability for retrieval of wastes; and
- (d) equity concerns such as the nature of impact assistance.

Actions were identified considering legal, procedural, and institutional constraints. Table 1 arrays the needed actions against the institutional framework of actors and points of controversy. For example, DOE development of policies and procedures for comparison and elimination of potential sites will provide a basis for identifying the intensity and specific nature of controversy by both NRC and specific

states on the process of site selection. Forums to negotiate consultation and concurrence with individual states and for reaching consensus with the State Planning Council (SPC) on site comparison can then be established for resolving conflict and building a coalition of support for the DOE program.

Figure 2 sequences the actions in a path and identifies:

- actions where there is shared authority with another federal agency;
- actions where there is shared authority with non-federal actors; and
- actions where Congressional approval is required.

There are 21 actions in Figure 2 where the DOE shares decision authority with another actor or where DOE must obtain the approval of another actor. Since our analysis is at a high level of abstraction and the actions identified aggregate many actions and potentially disparate actors (e.g., two or more potential host states or communities), the siting component actually contains more than 21 shared decision points. As Jeffrey Pressman and Aaron Wildavsky showed, a project with 14 independent clearance points and a probability of agreement on each clearance point of 95% had a probability of project success of only .00395.[15] The decision points shown on Figure 2 are clearly not independent of each other and, in fact, obtaining concurrence on early decision points improves the probability of concurrence on certain of

[15] Jeffrey L. Pressman and Aaron B. Wildavsky, Implementation, University of California Press, Berkeley, CA, 1973.

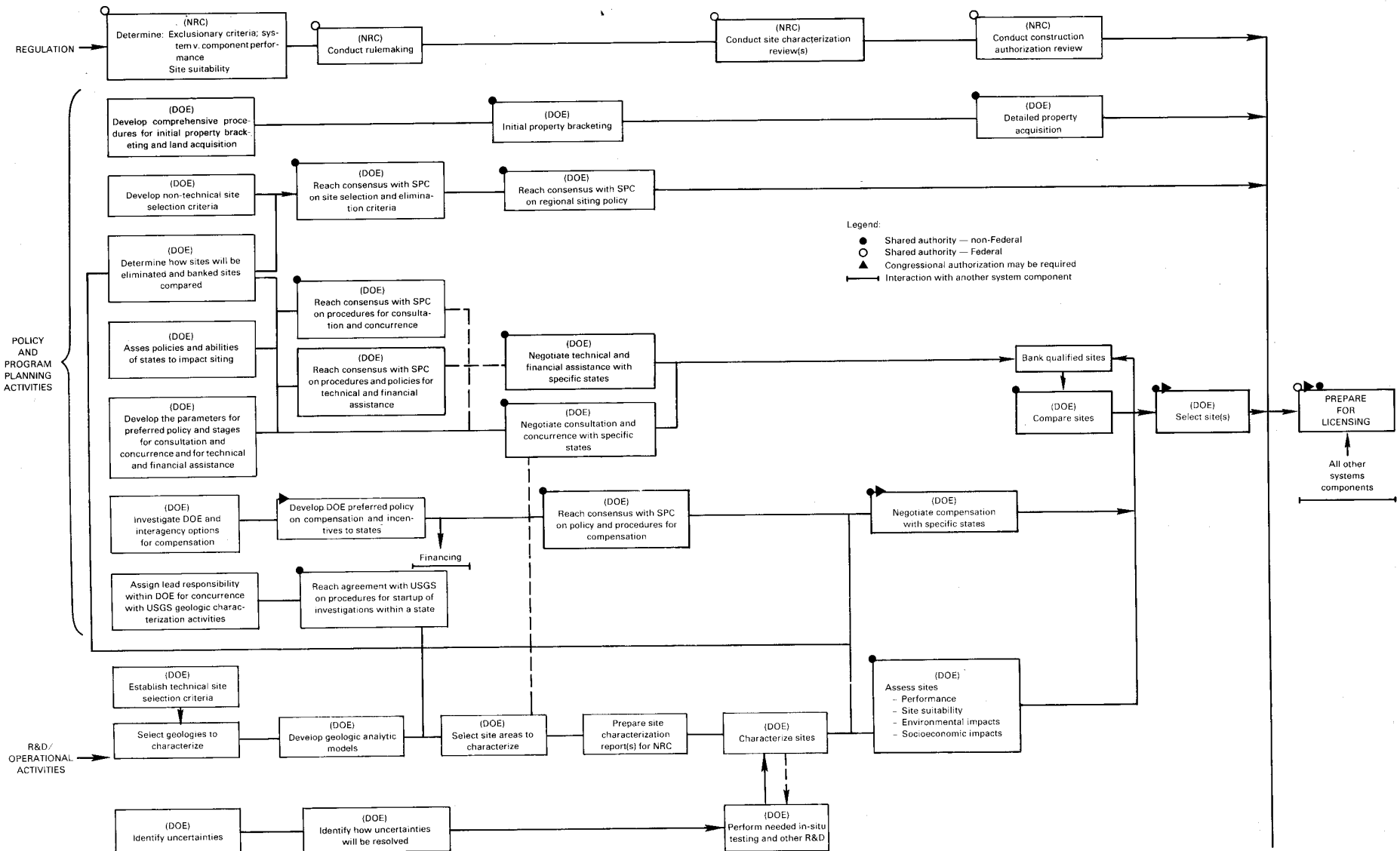


Figure 2--Path of Needed Actions--Siting

the latter decision points. But Pressman and Wildavsky's point that the number of decision points is inversely related to the chances of a project's probability of success is valid.

These numbers are in many ways misleading. The number of decision points and agreements that one can count in the siting process is not nearly as significant as the substantive issues that make shared authority necessary in the first place.[16] If the actors have irreconcilable interests, all parties may be more willing to bear the costs of delay than to give up without a fight. The significance of the controversies is a subjective evaluation, but we assume that many of the points of controversy listed in Table 1 (e.g., the perception of high potential risk, the nature of compensation of impacts to localities, the manner of participation of state and local governments, and the processes for selection among banked sites) represent major potential losses or gains to the interested actors. This view is supported by the historic and current opposition to the DOE HLW disposal program.

The number of actions which involve shared authority for each of the seven system components is shown on Table 2. Given the frequency of potential institutional obstacles to repository siting, development and operation, and the nature of the controversies which lead to institutional constraints, we conclude that the sharing of authority among DOE and other actors is the driving institutional consideration in implementing a disposal program.

[16] See E. Bardach, The Implementation Game, for a more detailed discussion of the shortcomings of the Pressman and Wildavsky study.

Table 2

FREQUENCY OF SHARED AUTHORITY

System Component	Number of Points of Shared Authority		
	Federal Agency	Non federal	Congressional
Siting	4	13	4
Facility Design & Construction	3	3	2
Waste Package	3	1	2
Radiologic Monitoring	5	2	0
Financing	1	4	4
Transportation	8	14	2
Operation/Administration/ Personnel	8	5	0

III. IMPLICATIONS FOR HLW PROGRAM IMPLEMENTATION:

REQUIRED CAPACITY FOR STRATEGIC MANAGEMENT

The frequency of shared authority plus the nature of potential costs incurred by other actors place significant demands on the DOE HLW program:

1. Shared authority affects which institutional arrangements and decisionmaking processes are feasible--which ones will lead to an operating HLW repository.
2. The environment in which implementation takes place will be continually changing. This results from changing attitudes of critical actors, instructions from Congress, the Secretary, and the President, actions taken by other actors, and additional information about disposal technologies. The environment will also change in response to actions and procedures implemented by the DOE. Some of these actions will mobilize new actors (such as new interested communities as sites are characterized) or will change the costs imposed or benefits conferred on other actors and therefore will influence the intensity and manner of their support or opposition.
3. Shared authority means that DOE cannot make unilateral decisions. Actions and decisions which are feasible in light of the institutional constraints must be identified with the participation of other actors.

As a result of these three realities, the mechanisms for accurately identifying institutional constraints and for responding to the interests of other actors are of great importance to the successful development and operation of an HLW repository. Throughout the implementation of the program, DOE must be able to alter its plans to reflect changes in the environment or changes in information about the environment. This ability requires a form of continuing planning and program implementation that we term strategic management.

Strategic management is a dynamic style of management which permits the DOE to set and modify program objectives in light of the changing interests and powers of influence of non-DOE actors. It requires the ability to (1) monitor the environment and changes in the environment, (2) develop and modify plans in a flexible and continuing fashion in response to new information about the environment, and (3) to negotiate with other actors to reach mutually acceptable outcomes or processes.

These are continuing activities. Strategic planning[1] must respond to a changing environment and must also provide for the needs of negotiators. The negotiations themselves provide information about the interests and powers of other actors that will lead to revised plans. The evaluation of current strategies as part of ongoing monitoring will lead to improved strategic plans. Traditionally, in government and most

[1] Robert Anthony defines strategic planning as the process of deciding on objectives of the organization, changes in those objectives and the procedures for accomplishing those objectives. Anthony distinguishes strategic planning from "management control . . . the process by which managers assure that resources are obtained and used effectively and efficiently in the accomplishment of the organization's objectives." Robert N. Anthony, Planning and Control Systems: A Framework for Analysis, Graduate School of Business Administration, Harvard University, Boston, 1965, pp. 16-17.

corporations, a single planning exercise sets forth program objectives and policies. These objectives are realized by developing and implementing operational plans. The process is a linear one. The planning exercise may be reviewed and updated annually and overhauled every few years. Traditional management styles are, unfortunately, not appropriate to the dynamic environment in which DOE must implement an HLW disposal program.

Strategic management is a concept which evolved in business administration.[2] In the middle fifties many American firms were confronted with static or declining markets for their goods in the face of vigorous competition from domestic and foreign firms. Traditional management techniques were not successful in restimulating demand. The new approach which developed independently in many companies through trial, error and some exchange of experiences became known as "strategic planning." But the strategic plans of the '60s and '70s for most companies took no account of the dynamics of implementation and of the institutional and political environment. As government regulation increased, public opinion was mobilized in new and effective ways, foreign competition became more vigorous, and improved communication shortened many important lag times, the rigidity of management became apparent. The newly evolving management style of strategic management is particularly concerned with (1) all aspects of the environment including political and psychosociological variables, (2) implementation

[2] H. Igor Ansoff, Roger P. Declerck and Robert L. Hayes, "From Strategic Planning to Strategic Management" in From Strategic Planning to Strategic Management, edited by H. Igor Ansoff et al., John Wiley & Sons, 1976, pp. 39-40.

of strategic plans--attention is given to the execution of action steps involved in these plans, and (3) the internal organizational changes which are necessary in order to carry out implementation.[3]

The term "strategy" comes from the theory of games. Games of strategy are those in which the best course of action for each player depends on what other players do. The theory of strategic games is an analogy which provides a useful outlook on the management of an HLW disposal program.[4] It takes the existence of conflict for granted and employs the image of gaming or of participants who try to "win." [5] We use the term strategy to focus on the interdependence of the player's decisions and on their expectations about each other's behavior.

We compare the siting and operation of an HLW repository to a "variable-sum game": the sum of the gains of the participants involved is not fixed; the gain of one actor is not balanced by an equal loss by other actors (as in a zero-sum game). Instead there is a common interest in reaching outcomes that are mutually advantageous. The DOE, then, should employ strategies which lead to gains by all or most players. This will increase the public good of HLW disposal and also

[3] Ansoff et al., pp. 1-12. See also Frederick W. Gluck, Stephen P. Kaufman, and A. Steven Waleck, "Strategic Management for Competitive Advantage," Harvard Business Review, July/August 1980, pp. 154-161.

[4] In the mathematical theory of games, the strategy is a statement made by or about a player before the game begins specifying exactly what action he will take under every conceivable situation that can arise in the course of the game. Strategic management, on the other hand, calls for the evolution of strategy as the environment is evaluated and as changes in the environment occur. Moreover, the environment facing the DOE is so complex that no rules or strategies could be formulated completely prior to embarking on strategic management.

[5] See Thomas C. Schelling, The Strategy of Conflict, Harvard University Press, Cambridge, Massachusetts, 1963, for discussion of a strategic gaming and the implementation of plans in conflict situations.

decrease opposition to the HLW program. For example, it is to the advantage of the state governments and to the federal government to dispose of HLW. The potential gains to state governments is not simply the reduction of risk from exposure but also the potential for enhancing the economy of the state and the stability of the economic environment for electric power generation. Similarly, for those environmental groups who want to assure that federal waste management decisionmaking follows certain procedural rules and involves active public participation, a siting process which satisfies these actors can be viewed as a gain to all actors. There is clear evidence that important segments of the concerned communities (states, localities, environmental organizations, industry representatives, as well as the federal government) view the safe disposal of HLW as a vital objective.[6]

The analogy of gaming does not apply when there is no scope for mutual accommodation, no common interest even in avoiding mutual disaster. There will be actors who do not share the objective of safe disposal of HLW. For example, some opponents of nuclear power might use the lack of a repository as a weapon in their fight to shut down the commercial nuclear industry. Although it may not be a comfortable notion, this is an example of conflict that will exist regardless of the actions of the DOE and which the DOE will not be able to resolve. This controversy will have to be managed in a way which does not adversely affect the morale of the DOE staff. We do not deal with the means to accomplish this task in this study.

[6] See Nuclear Waste Management Process Review Forum, RESOLVE, Center for Environmental Conflict Resolution, Final Report, June 1980, p. 1.

Strategic management, then, results in a flexible management system which changes according to the outside environment; a system which accommodates to the interests, perceptions, and actions of others who can influence the implementation of the HLW disposal program. In the words of Pierre Tabatoni and Pierre Jarniou,[7]

there is no "strategic management" unless the organization is willing and able to develop a critical appraisal of its own management conception and practice, through the search for and the implementation of innovative strategies.

Strategic management involves three interactive elements:

1. information gathering
2. strategic planning, and
3. bargaining and negotiation.

INFORMATION GATHERING

Information gathering is the awareness of the external environment facing the DOE and an awareness of changes in that environment. Continuing with the analogy of gaming, we are directed to look at the players, what they regard as the stakes, their strategies and tactics, how they respond to current DOE strategies, their resources for playing, their formal or informal authority (power to affect outcomes), the nature of communication among players, and the degree of uncertainty surrounding the possible outcomes. We are also directed to look at who

[7] Pierre Tabatoni and Pierre Jarniou, "Dynamics of Norms in Strategic Management," in From Strategic Planning to Strategic Management, edited by H. Igor Ansoff et al., John Wiley & Sons, 1976, p. 33.

is not willing to play (for example, those referenced above who desire the end of the commercial nuclear industry) and those who would become players upon change of the parameters of play. It is important that DOE understand its environment and its actions from the perspectives of others--to understand the attitudes and interests of other actors. This suggests that individuals with diverse perspectives be involved in information gathering.

Our evaluation of the institutional framework for each system component in Section III and the Appendixes serves as a simplified and preliminary example of the information which the DOE must gather to engage in strategic management. We have not explicitly evaluated the players' stakes, resources, authority, or degree of uncertainty surrounding the outcomes, although some of the implicit judgments are embodied in the identification of points of controversy. A refinement of this framework, especially the resources of actors and their stakes (and therefore their incentives to organize in order to enhance their political power), should be the subject of follow-on tasks for the DOE staff.

There are two primary methods for information gathering. First, the DOE could rely on observation of the environment and only require passive participation of other actors. Second, the DOE could monitor the environment by means of active participation of other actors. The methods are complementary. The adjectives "passive" and "active" refer only to the involvement of the other actors; DOE will need to develop affirmative and active programs of intelligence gathering in order to accurately monitor the environment.

Passive participation is particularly important for assessing the resources available to the other actors and their standard means of exercising influence in other arenas where their interests are affected. Illustrations of gathering information through observation include:

- reading the publications of other actors,
- attending, as observers, the meetings of other actors in which radioactive waste management or other nuclear issues will be discussed;
- tracking state legislation; and
- evaluating the political interests and structures of potential host states and communities.

These are all activities in which DOE currently engages. Therefore, observation can be accomplished without significant commitment of additional resources. The DOE participants can direct and structure their observations and assessments consistent with the gaming analogy and the need to evaluate and re-evaluate the institutional framework or environment which faces the Department.

A cogent example of the benefits of this method of information gathering is related by the following comments of a representative of Standard Oil Company (of Indiana).[8] According to this source, his company was successful in siting a chemical plant in Berkeley County, South Carolina, an area which had consistently blocked similar development in recent years. He attributed success to their policy of

[8] Conversation with Harry Brennan, Director of Environment and Energy Conservation, Standard Oil Company (Indiana), August 1980.

attending the public meetings in the target community sponsored by a competing company. By observing other public meetings where a competitor was defending a decision to site a similar facility, the Standard Oil Company representatives were able to enumerate and evaluate the specific community interests which resulted in historic opposition to industrial development. When Standard Oil announced its desire to site a chemical plant in the community, it had already anticipated the specific issues of opposition and was able to respond and negotiate immediately with prepared answers to concerns or packages of compensation. The cooperative and compromising position of the company achieved cooperation in return from the community and resulted in the successful siting and operation of the chemical plant.

Active participation of other actors in order to monitor the environment can be a particularly useful objective of public participation programs sponsored by the DOE. When used to this end, in addition to receiving comments on specific proposals and documents developed by the Department, participation programs are designed to identify concerned organizations (actors), their stakes, interests, modes of communication, willingness to play and so on. The recent efforts to involve the public by way of small group meetings and large regional meetings in the national planning process are an important step in this direction. Examples of participation programs designed to elicit issues and points of controversy or to build agendas for action can be found in the efforts of the EPA in their environmental protection programs, in the State workshops on siting of HLW repositories held by

the NRC in 1977[9] and the programs of the Bureau of Land Management (BLM) in planning uses for parcels of BLM-administered lands. Again, the DOE is actively developing programs for public participation and therefore the information gathering component to strategic planning should not require significant additional resources.

Active and passive participation are complementary activities. They can be used as cross-checks about the nature of potential controversies, to evaluate the effectiveness of DOE strategies, and to judge the existence or potential for forming coalitions.

STRATEGIC PLANNING

Strategic planning formulates objectives and delineates alternative actions for the program in light of overall goals and the information that is gathered about other interests involved in program implementation. The success of Standard Oil in siting their chemical plant results from their ability to take the information gathered and to modify their actions in response to the interests and influence of other players in the game. In broad outline, strategic planning involves:

1. knowing what to expect (the evaluation of information gathered),
2. determining how to respond or adapt to the constraints imposed by other actors, and
3. identifying and influencing those aspects of the environment

[9] Workshops for State Review of Site Suitability Criteria for High-Level Radioactive Waste Repositories, NUREG-0353 and NUREG-0354, U.S. Nuclear Regulatory Commission, Washington, D.C., February 1978.

which are subject to DOE influence so as to enhance the likelihood of program success.

Knowing What to Expect

The first stage in strategic planning is to reduce the information gathered into an agenda for action (or response). Major issues that would fall on a "critical path"--controversies that must be overcome to achieve success--can be identified for each group of actors (e.g., the "states" in aggregate, the "communities," and so on). From the evaluation which went into the identification of points of controversy we suggest a preliminary set of issues for siting in Table 3. The list is intended to be illustrative not exhaustive. We are confident that DOE has developed a comparable list of issues.

The DOE must, then, prepare itself to respond to and anticipate the differences in the interests of players within the same group (e.g., differences among the states, among the potential host communities, and among environmental organizations). Although major issues or points of controversy can be identified for groups of actors, the individual interests of members of those groups will diverge. As J. Murphy suggests in considering approaches to low-level radioactive waste burial[10]:

[10] J. L. Murphy, "Establishing Low Level Waste Repository Sites: The Question of Compensating Benefits," The Energy Research Group, Inc., August 13, 1980.

Table 3

MAJOR SITING ISSUES

Levels of Acceptable Risk

Health (from potential radiation exposure)
Safety (e.g., risk of routine injury from construction, transport of materials, and operation of repository)
Environmental

Distributional Issues

Distribution of risk from waste disposal
Distribution of benefits (equity)
Distribution of responsibility for waste disposal

Procedural

Role for State/Local governments--procedures for consultation and concurrence
Process for selecting sites to characterize
Process for choosing among banked sites
Process and timing of identification of impacts

Credibility

Of DOE process and procedures
Of DOE personnel
Of NRC process and procedures

Economic [largely responded to by compensation and/or incentives]

Economic development of host community and host state
Safety/economic tradeoffs (e.g., the extent and nature of land use controls)

Social [largely responded to by compensation]

Sense of well-being (of host state and host community)
Public conveniences and services of host community
"There goes the neighborhood"

The value of compensation, after all, is in the eye of the beholder. Communities tend to exhibit wide variance in priorities, growth policies and styles of governance. While one community may be eagerly seeking economic growth, another might be oriented toward strictly limiting growth. The differences are important. For example, one community might welcome a burial facility, with a large protective buffer around it, as a means of controlling growth while providing good municipal services with a low residential tax rate.

Yet both hypothetical communities will be interested in transportation routing, compensation for socioeconomic impacts, reduction of potential exposure, and programs for emergency response.

The DOE does recognize that there are important differences among the states as evidenced by their case-by-case approach to consultation and concurrence with individual states. Strategic planning provides a decisionmaking structure to enhance and complement the need for case-by-case responses to specific actors within a group.

Six classes of questions must be answered in order to "know what to expect":

1. Who will oppose the program;
2. Which are critical points where controversy must be resolved in order for the program to be successful;
3. What are the manner and forums for opposition (or support) of other players;
4. Where in the program plan will the critical points occur;
5. What are "acceptable" responses to the interests of other players as viewed by those players (what is their view of equity and a fair process) and how successful are current strategies in responding to other interests; and

6. Whether the actors who are likely to oppose the program will become players--whether they are willing to engage in compromise because they have something to gain or because they are interested in preventing loss.

The answers to the first four questions are largely unaffected by the DOE. They occur regardless of the details of the DOE program to dispose of HLW.[11] The answers to the last two questions can be affected by the DOE, and strategic management should aim at changing them in favor of DOE. The information gathering program component should be structured so as to provide information to answer each of these questions. The activity shown on the far left in the middle of Figure 2 (see p. 35) entitled, "Assess policies and abilities of states to impact siting," is an example of an activity in this stage of strategic planning.

Determining How to Respond

The next stage of strategic planning is to determine how the Department will respond to the constraints imposed by other actors. This involves:

- evaluating the range of actions legally open to the DOE;
- determining the range of actions which DOE is willing to take to respond to the interests of other actors; and

[11] The fourth question, which asks where in the DOE process opposition is likely to occur can, in fact, be substantially influenced by the DOE, but for purposes of simplicity in this study we will take the overall structure of the DOE program as given.

- seeking additional authority to take action if important in responding to outside influences.

A first task is to evaluate the range of actions legally open to the DOE. For example, another of the early actions identified in Figure 2 is to "Investigate DOE and Interagency options for compensation to the states." DOE has addressed this question and found that existing law provides two primary mechanisms to deal with socioeconomic impacts which typically result from any federal project having conventional work force and supply service requirements: "(1) allows DOE to make payments in lieu of the tax revenues which would have been paid for such property in the condition in which it was acquired and (2) provides for financial assistance to those local educational agencies upon which the Government has placed financial burdens." [12] DOE recognizes the limitations of these mechanisms and is looking at ways to finance directly community services such as fire protection and studying the applicability and availability of the various programs described in the Catalog of Federal Domestic Assistance. The action referred to above and found in Figure 2 would be accomplished once DOE has completed these investigations.

The purpose of strategic management is to permit the DOE to condition its actions on the changing interests and attitudes of other actors; this implies the need for flexibility in the DOE response. Flexibility can be enhanced by determining the range of responses (or

[12] Statement for the Record of George W. Cunningham, Assistant Secretary for Nuclear Energy, Department of Energy, before the Subcommittee on Rural Development, Senate Committee on Agriculture, Nutrition, and Forestry, August 26, 1980.

outcomes) acceptable to the Department as opposed to deciding upon a single acceptable response.

The decisions about the range of actions which DOE is willing to take to respond to the interests of other actors are policy determinations. The identification of major issues during the first stage of strategic planning provides a structure and checklist for the policy determinations at this stage.[13] For example, one of the economic issues found in Table 3 is manifested in some communities by concern over the "extent and nature of land use controls." If DOE finds that a variety of land uses on the buffer zone around a repository would not adversely affect repository integrity, then those uses can be identified and different uses can be allowed at different potential sites. Similarly, if a host community doesn't want a land use that DOE would find acceptable, DOE could agree to eliminate that potential use in their arrangements at that site. The identification of the range of acceptable uses in advance allows flexibility to the official negotiating with the host community. In addition, it specifies the extent of his authority and enhances his ability to offer alternatives, compromise, and commit the DOE without returning to headquarters for guidance.

The procedures for consultation and concurrence is receiving a lot of attention by the DOE and other actors. DOE could identify such things as:

[13] Because the DOE is the sole entity with responsibility to site and operate an HLW repository, we assert that DOE must be responsive to all potential constraints to repository operation.

- the officials it is willing to consult or from whom it will accept "concurrence" at different stages of the siting process (e.g., if DOE allows state objections to halt or prevent detailed site characterization, must objection come from the governor, would legislative action be sufficient, action by a legislative committee, action by an executive agency);
- the decision points at which it will halt action if a certain official or group of officials object;
- the decision points at which it will not halt action;
- the types of information available and the alternative forums for discussing information available and forthcoming;
- the types of technical assistance available at different stages of the siting process; and
- exclusionary criteria--technical and socioeconomic or environmental factors which would eliminate a site from consideration.

By identifying all the parameters for consultation and concurrence which the Department finds acceptable, flexible arrangements can be negotiated with each affected state or community. Establishing the range of alternatives acceptable to DOE places necessary constraints on and provides guidance to DOE negotiators while also providing information and certainty to the states and the State Planning Council in working out specific arrangements with DOE and among themselves.

Adaptive behavior or the strategic adoption of a range of

acceptable outcomes will require difficult tradeoffs.[14] For example, the identification of institutional factors or criteria which reduce the desirability of candidate sites will probably eliminate potential sites which could meet hydrologic, geologic and other technical site selection criteria. Similarly, agreeing to special rail tariffs not imposed by the ICC might increase operating costs. Nonetheless, these tradeoffs might be necessary to establish a range of outcomes or processes acceptable to critical non-DOE actors--ones who could obstruct program implementation.

Concurrently, DOE would assess whether additional statutory authority would enable the Department to respond more acceptably to the interests of other actors. Additional authority can be sought where necessary and the gains from such additional authority can be outlined in support of the proposed legislation.

The consequences of taking action without the benefit of strategic planning are (a) increased opposition to the HLW disposal program, (b) the inability to make strategic tradeoffs between the benefits and costs of particular actions, (c) uncertain and potentially inconsistent outcomes, and (d) lack of flexibility in decisionmaking. For example, since DOE is not developing non-technical site selection criteria, candidate sites are evaluated according to technical criteria alone.

[14] Such tradeoffs are also made by strategically managed corporations. Gluck et al. describe a typical corporate tradeoff as being between cost reduction and meeting strategically determined schedules for product introduction. Tradeoffs in the HLW disposal system will likely result in redundancy in safety or emergency response systems, potentially inefficient community response services, longer time schedules in order to resolve the interests of a number of actors, equity tradeoffs, and recognition of estimates of perceived risk as a parameter for safety and response systems versus DOE assessed probabilistic or deterministic risk estimates.

This has resulted in the DOE's requesting that the Department of Interior allow investigatory drilling on federal land in Utah which is under consideration by BLM for wilderness designation. The requests and the exclusion of interested actors in deciding whether to make the requests (which were ultimately deferred by DOE) generated controversy with the DOI, with environmental interest groups, and with local residents.[15] The identification of institutional factors which might reduce the desirability of candidate sites, or a process to consider the political or institutional consequences of characterizing particular geographic regions, would have allowed a strategic tradeoff between the value of information to be gained from drilling of the site in Utah and the cost of additional opposition generated by the request to drill.

Influencing the Environment

Strategic management can also be advanced by influencing the environment--modifying the constraints facing the DOE. We return to the two aspects of the environment which DOE is able to influence:

- what are "acceptable" responses to the interests of other players, and
- whether the actors who are likely to oppose the program will become players--whether they are willing to engage in compromise.

[15] Based on conversations with officials in the Columbus Program Office and with Brant Calkin, Southwest Regional Representative of the Sierra Club.

DOE may be able to modify what other actors consider acceptable responses to their interests through the attitudes, procedures and processes which DOE employs in making decisions. For example, if one of the critical issues resulting from the states being actors is different concepts about the manner and time period for retrieval of emplaced wastes, the process used to reach scientific judgments about repository performance might be a determinant of the strength of the states' interest in retrievability. If the decision process is a determinant, then a process which builds confidence and familiarity may reduce the intensity of potential opposition at this juncture. The DOE programs are currently designed to fully inform state governments about their activities. The information gathering process can be used to evaluate whether these activities are, in fact, garnering confidence or whether supplementary or alternative processes would be more effective.

It is to DOE's advantage to try to change the rules of play in order to make all actors players. If there are actors who can influence the DOE program but who do not believe that they have anything to gain and something of interest to lose, they will not be willing to compromise and are not "players" in the game context. For example, a potential host community may perceive the costs and risks of a repository to so far outweigh the benefits that they will be uncompromising in their attitude of "not in my backyard." Mitigation of impacts, even using a broad interpretation of the current legislation, might not suffice to make this community a "player." The availability of incentives, on the other hand, in addition to compensation might provide a compensating gain and bring an uncompromising opponent to the

bargaining table. The need to consider incentives is recognized by the DOE[16] and by others concerned with the siting of HLW repositories and other hazardous facilities.[17]

The use of incentives is also a traditional tool of the federal government in implementing objectives through the federalist system.

To achieve many of its domestic purposes, including community development, the federal government relies on local governments. However, because of the division of authority among governments in the federal system, the federal government cannot order these governments to do anything. It gets them to carry out its purposes by offering incentives in the form of aid, which they may accept or not, and by attaching conditions to the aid. To achieve results, federal officials must have enough knowledge of local politics to perceive what incentives are necessary; they must supply the incentives in sufficient quantity; and they must direct the incentives to those holders of local power whose support is required to achieve the federal purposes. In short, they must intervene successfully in local politics.[18]

The EPA is an example of a federal agency which is actively trying to influence the environment for siting "undesirable" facilities. It is in the process of developing a handbook for states in the use of compensation and incentives in hazardous waste facility siting.[19] This process has the potential to (a) aid EPA in "determining how to respond," (b) change the attitude of other players by cooperating with them in realizing their interests and (c) make non-players players by demonstrating that it can be to their advantage to site a facility.

[16] See Dr. Cunningham's statement of August 26, 1980, p. 8.

[17] For example, see Michael O'Hare, "Not on My Block You Don't: Facility Siting and the Strategic Importance of Compensation."

[18] Martha Derthick, New Towns In-Town: Why a Federal Program Failed, The Urban Institute, Washington, D.C., 1972, p. 84.

[19] Environmental Consensus, Fall 1980, RESOLVE, Center for Environmental Conflict Resolution, Palo Alto, CA.

BARGAINING AND NEGOTIATION[20]

Many have an uneasy feeling when negotiation or political bargaining is discussed as a component of executive agency decisionmaking.[21] Nonetheless, negotiation is necessary when actors (a) have different interests and therefore different policy preferences; (b) are sufficiently powerful to influence a policy outcome; and (c) regard some resolution to differences as preferable to none--are willing to become players.[22]

Implementation of the strategic planning process discussed above depends upon the bargaining or political process in order to achieve strategic adaptation--to resolve or accommodate the potential institutional constraints to a disposal program. Scholars in the fields of implementation (implementation of governmental, usually federal, programs) as well as business administration highlight the importance of bargaining and negotiation to the success of programs where there is significant influence from outside the organization.[23]

[20] Bargaining is commonly used to describe a marketplace or barter situation where two or more individuals are coming to terms on exchange of goods or services. Negotiation is the process of resolving disputes more generally. Despite this distinction and because the terms are often used interchangeably in the implementation literature, the terms are used synonymously in this paper.

[21] It must be understood that negotiation raises the risk of misinterpretation and the fear that protection of public health and safety will be compromised. Therefore, the institutional program components must be fully integrated with the technical components and set within a credible and fully articulated decisionmaking process.

[22] William C. Mitchell, "Bargaining and Public Choice," Readings in Managerial Psychology, Second Edition, edited by H. J. Leavitt and L. R. Pondy, University of Chicago Press, 1973, p. 583.

[23] See, among others, Graham Allison, The Essence of Decision; Richard Elmore, "Organizational Models of Social Program Implementation," Public Policy, 26,2: 185-228; Eugene Bardach, The Implementation Game, Pressman and Wildavsky; Schelling and Ansoff, et al.

The role of negotiation is to reach agreement on acceptable outcomes. Conflicts among DOE and non-DOE actors in the exercise of their responsibilities can result from differences in goals, differences in preferred means, or differences in perceptions of equity. All of these differences will exist in nuclear waste management because the non-DOE actors have a different, and usually broader, policy charter than does the Office of Waste Management. These actors do not view waste management in isolation of their broader mandates. It is not important that DOE and non-DOE actors reach agreement on goals or values, only that they reach a mutually acceptable outcome.[24]

In Figure 2, needed actions, alternatively termed "negotiating" procedures or agreements or "reaching consensus" with an influential political body such as the host state, are all junctures where bargaining will come into play. And DOE is participating in such forums when reaching agreements regarding site characterization with potential host states, when participating in meetings of the State Planning Council, during informal discussions with Congressional committee staff, and so on.

There are four important determinants of how well DOE will fare in these bargaining forums:

- the statutory and informal authority possessed by the DOE and the pattern of its delegation within the organization;

[24] Charles E. Lindblom, "The Science of 'Muddling Through'", reprinted in Readings in Managerial Psychology, Second Edition, edited by H. J. Leavitt and L. R. Pondy, University of Chicago Press, 1973.

- the accuracy of the information gathered and in the ability of the DOE staff to translate this information into major issues or controversies (the ability to monitor the environment and to anticipate institutional obstacles);
- the ability of the DOE to develop a range of alternatives which will satisfy the individual actors in the controversies; and
- the skill of the DOE officials who engage in bargaining.

Successful negotiation requires recognition that a spectrum of acceptable solutions to HLW disposal exist. The solution to nuclear waste management is usually thought of as a single solution.[25]

Whereas some of the engineered repository components may have an optimal solution, this is not true for the institutional components. Instead a spectrum of acceptable or satisfactory solutions exist. All acceptable solutions must protect public health and safety and minimize environmental impacts; but different financial arrangements, emergency response programs, levels or types of compensation to states, procedures for state concurrence, and transportation routes could all be acceptable. The alternatives, though acceptable, are not all equally preferred by DOE.

The selection or rejection of alternatives from the spectrum of solutions acceptable to DOE will result from negotiation in one form or another. The likelihood for successful resolution of differences (for

[25] Past and current efforts at agency or interagency planning have been directed toward: specifying operational goals; assessing the state-of-the-art (engineering, geological, waste migration, etc.); defining intergovernmental responsibilities; and coordinating agency schedules. Such planning formulations encourage the perspective that an optional solution is available.

success in developing a repository), as well as the timeliness of the resolution of controversy and the sum of "gains" of the players, will depend on the DOE's ability to develop a range of alternatives that it finds acceptable and that will also respond to the interests of the individual actors in the controversy.

Strategic planning must provide for the needs of DOE negotiators. The establishment during strategic planning of a range of alternatives that DOE is willing to take can be thought of as the identification of the spectrum of solutions acceptable to the DOE. This provides DOE the flexibility to compromise--it sets forth guidelines in which individual negotiators are free to move. Strategic planning also establishes the constraints beyond which an individual DOE negotiator cannot go when making decisions about when to halt investigatory activities, when to proceed with plans, what compensation can be granted to states for what types of impacts, when consultation can be said to have taken place, and so on. In addition, strategic planning as an input to bargaining (a) provides consistency among decisions, (b) enables the DOE to understand the interactions between a decision made in one area and other aspects of repository development, and (c) allows for knowledgeable and rapid reaction to the ideas and suggestions of other actors.

In the absence of establishing the range of acceptable outcomes in advance, the result of bargaining is an incremental and case-by-case approach which does not provide a basis for flexible policy decisionmaking.[26] Actions by a single individual at different times

[26] For a discussion of the problems of a case-by-case approach to granting regulatory waivers for synfuels development see N-1469-DOE, David Seidman, Values in Conflict: Design Considerations for a Two-Stage Synfuels Development Strategy, The Rand Corporation, April 1980.

or by different individuals will not be uniform and will not necessarily lead to a desirable policy outcome, since no comprehensive planning and evaluation are available to facilitate policy coordination at the headquarters level. Lacking policy guidance, officials will hesitate to take action[27] and are unsure of the legality or acceptability of alternatives. Since initiatives in the absence of established policy parameters are likely to set precedents, actions need to be approved on an individual basis resulting in a redirection of staff effort and delay.

The skill of the negotiator is also important to the success of the DOE. The negotiations in which DOE will engage are part of the larger political arena. The objective of bargaining is to advance the interests of the bargainer's constituency, but there are informal and widely accepted rules of the game. If bargainers do not use means that other players feel are legitimate and appropriate, the outcome itself will be viewed as illegitimate.[28] Some of the important elements of successful negotiation include:

- inspiring trust;
- keeping promises;
- willingness to compromise;
- observing established and conventional rules of behavior;
- advance notice of change of position;

[27] Discussions with Field officials confirmed the inclination to postpone action as a result of uncertainty in the face of incomplete policy guidance regarding interactions with potential host states.

[28] William C. Mitchell, p. 583.

- honoring the office of the other players; and
- self-restraint.[29]

Negotiation is a delicate process which requires "credibility and some measure of mutual confidence among negotiating parties." [30] Malcolm Rivkin, who has been involved in negotiations involving community development, considers that a crucial quality negotiators must display is sensitivity to other viewpoints:

The developer must accept the legitimacy of citizen and environmentalist concern, and the citizen must be willing to consider economic interests. Governmental decisionmakers need to balance conflicting views against their own interpretation of a broader public interest, recognizing that these positions are themselves components of that public good. Civility--or at least a willing suspension of the acrimony that often accompanies debate over environmental issues--is basic. Regretably, a readiness to communicate and to absorb (if not accept) a deeply felt contrasting position does not come easily to many.[31]

Strategic management is a dynamic and iterative process. Negotiations will provide additional insight for the information gathering activities. As decisions are made and the program progresses, the actors and their stakes will change. The information gathering and strategic planning components will monitor the environment in order to observe and anticipate these changes. New controversies will be identified and old ones, hopefully, resolved. New plans will be formulated in response to changing interests and attitudes of other actors. Even though it is useful to think of strategic management as

[29] Mitchell, p. 587.

[30] Malcolm D. Rivkin, "Negotiated Development: A Breakthrough in Environmental Controversies," Environmental Comment, May 1977, p. 5.

[31] Rivkin, p. 5.

having three steps which follow one from the other, it is clear that in a dynamic environment all these activities will have to take place concurrently. DOE will become progressively adept at strategic management as it learns from experience.

IV. CAPABILITIES REQUIRED TO PLAN AND IMPLEMENT AN HLW DISPOSAL PROGRAM

Thus far, this study has developed the premises that (1) DOE has the sole responsibility to site, develop and operate an HLW repository and (2) there are many other actors inside and outside the federal government who can influence the DOE program to dispose of HLW. The points where DOE shares authority with another actor are numerous and involve significant controversies. This implies the need for strategic management capabilities--the ability to set and modify program objectives and implementing activities in light of the changing interests and authority of non-DOE actors. This section compares the existing capabilities of the DOE with the required capabilities for strategic management identified in Sections II and III.

THE DOE HLW DISPOSAL PROGRAM

The DOE mandate for HLW disposal is supplemented in the Department by policy guidance. The policy guidance for nuclear waste management contained in the "Draft Policy, Programming and Fiscal Guidance; FY 82-86" dated January 30, 1980, calls for a strategy to develop the scientific and program capabilities leading to permanent disposal including:

- complete development of the scientific basis for nuclear waste disposal;
- demonstrate how the technologies for waste disposal can be integrated to assure system compatibility;

- display the key decisions in the disposal strategy and the environmental reviews and impact statements needed to support them;
- integrate logistical and interim storage considerations into the disposal strategy;
- integrate the state consultation process into the disposal strategy and resolve the jurisdictional aspects of the siting of needed facilities.

The translation of this policy guidance into implementation activities is revealed by the DOE program organization and internal (formal and informal) delegations of authority.

Program Organization

The DOE program for HLW disposal is contained within a complex waste management organization under the direction of the Deputy Assistant Secretary for Nuclear Waste Management who reports to the Assistant Secretary for Nuclear Energy. The overall waste management program organization is depicted in Figure 3. In addition to programs in support of HLW disposal, the DOE also manages existing defense wastes. Complexity is introduced into the organization because budgetary and task distinction is made between similar nuclear wastes originating from defense and commercial activities. This distinction results, in part, from the Congressional appropriations and authorization process in which separate committees have budget authority over defense or commercial activities. It also results from traditional separation of these activities in the DOE and predecessor agencies and

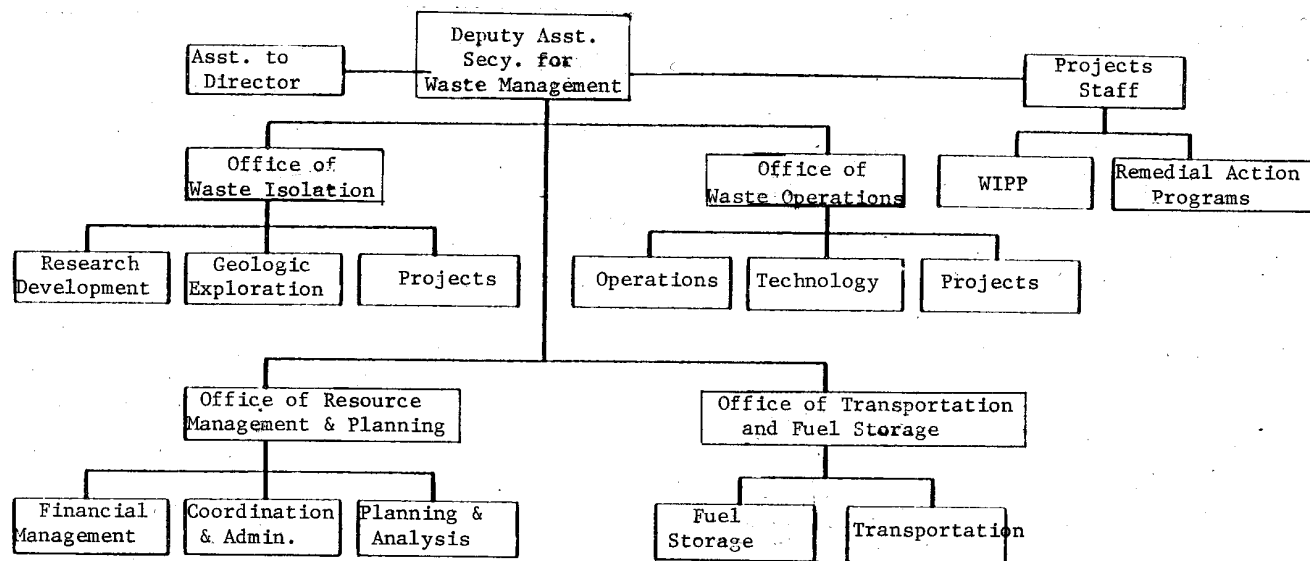


Figure 3 -- DOE Nuclear Waste Management Program Organization

can be traced to the incremental way in which the program was assigned new responsibilities. Many of the organizational units shown in Figure 3 have responsibility for activities in support of both defense and commercial activities such as the Office of Waste Operations, the Projects Staff, the Office of Resource Management and the Office of Transportation and Fuel Storage.

The siting component, which we continue to use for illustration, is wholly contained within the Office of Waste Isolation. The program administered by this Office is called the National Waste Terminal Storage (NWTs) Program and is shown in more detail in Figure 4.

The NWTs program is highly decentralized; three major DOE field organizations administer the program--the Richland Operations Office, the Columbus Program Office, and the Nevada Operations Office. Under decentralization, headquarters personnel are responsible for "development of overall plans, establishment of priorities, and analysis of program requirements." [1] The accomplishment of given program objectives rests with the Field. The primary contractors who carry out the operational tasks under the direction of the Field organizations are shown in the lower boxes of the organization chart.

Also shown in Figure 4 are the DOE full-time staffing levels for the headquarters staff of the Office of Waste Isolation and for the DOE NWTs Field staffs. Relatively small staffs (total DOE headquarters and Field siting staff of 44) administer a total of \$155.3 million.

Fourteen people in the Columbus Office direct Battelle's efforts at a

[1] Statement of Position of the United States Department of Energy, in the Matter of Proposed Rulemaking on the Storage and Disposal of Nuclear Waste, April 15, 1980, p. III-3.

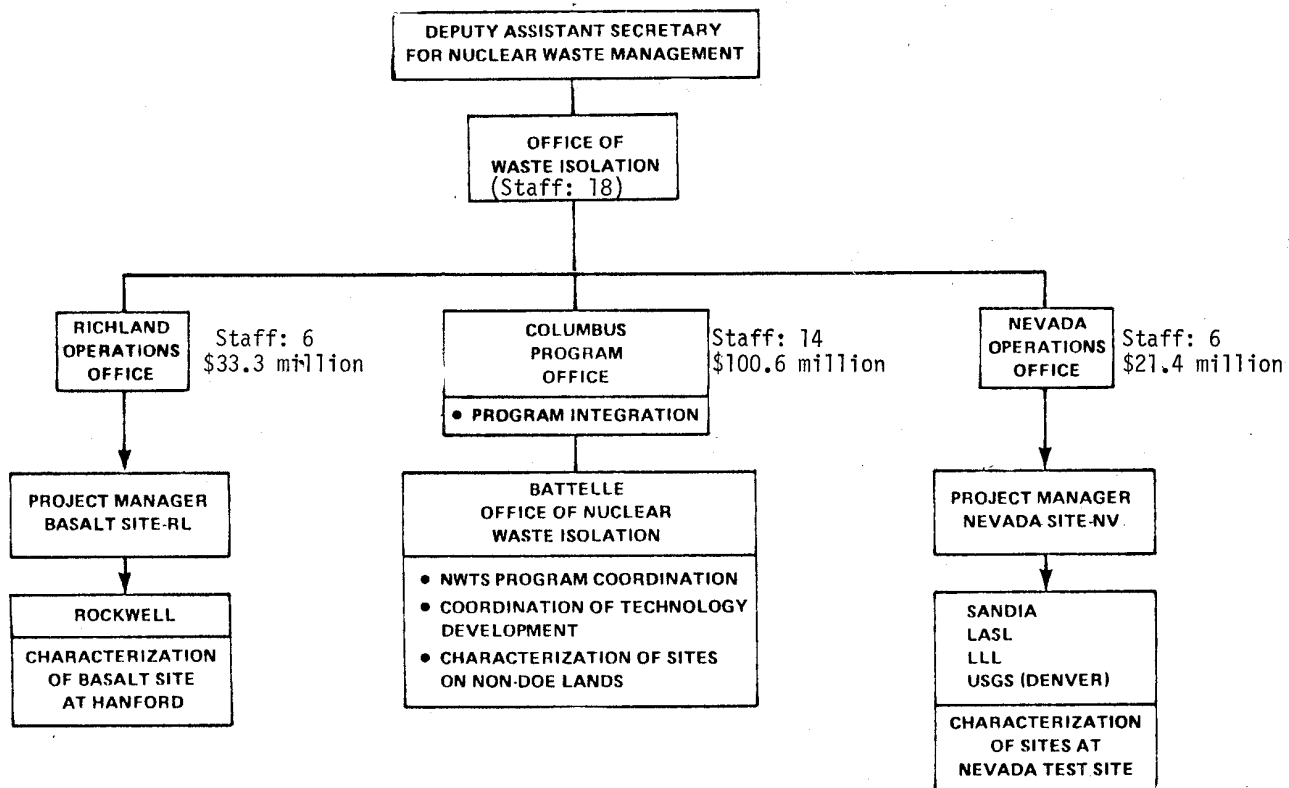


Figure 4 -- National Waste Terminal Storage Program Organization

funding level of \$100.6 million; six people in Richland direct Rockwell's efforts at a funding level of \$33.3 million; and six people at Nevada direct four contractors at a funding level of \$21.4 million. Most of this effort goes to site characterizations, which allocation is appropriate since these tasks are resource intensive. In addition Battelle, Office of Nuclear Waste Isolation performs technical program coordination of the diverse NWTs activities.

This highly decentralized organizational structure where small staffs plan and direct the expenditure of large sums of contract dollars is not unique to the waste management program. DOE as an organization has committed to this structure to facilitate the research and development functions for which it is responsible. The national laboratories which perform research and development and technical assistance for the Department are directly associated with DOE Field Offices and have over the years developed significant expertise for various tasks. The reliance on national laboratories and contractors also results from the tendency of the Congress and the Office of Management and Budget to increase contractual support for new and expanding programs without corresponding increases in staffing levels.

Review of program documents, policy guidance, delegations of authority to the Field, and interviews with project managers confirms NWTs program concentration on geologic site characterization with the objective of developing sufficient site-specific analyses to select a repository site from among potentially suitable geologic media.

Delegations of Authority

Each of the project offices has a separate charter or management agreement which formally delegates responsibility and is signed by the Deputy Assistant Secretary for Waste Management and by the program managers in the Field. Although each of the agreements is somewhat different, many elements are similar. In all cases, the Field office is charged with project administration, and headquarters is charged with overall project monitoring, guidance, and approval. Tables 4 and 5 array the delegated and reserved authorities, respectively, for each Field organization. For purposes of this study, the significant differences in delegated authorities involve:

- interaction with the NRC,
- interaction with state and local governments,
- interaction with non-governmental parties,
- legislative analysis, and
- approval of major program initiatives.

According to formal delegations of responsibility, the Nevada and Richland Field organizations have far broader authority to act in these areas than does the Columbus program. Major elements important to an implementation strategy such as state and local policy initiatives, legislative analysis, and approval of program initiatives appear to be withheld from Columbus but not from the other Field organizations. This can be attributed in part to the broader and more complex scope of the NWTS program and to the long-established coordination and interaction among the Nevada and Richland Field Offices and their respective host

Table 4

FIELD AUTHORITIES

Responsibility	Nevada	Richland (BWIP)	Columbus (NWTs)
Prepare an annual Project Plan which incorporates headquarters guidance outlining the work to be performed, resources required to perform this work, and the scheduled performance	x	x	x
Administer DOE program responsibilities	x	x	x
Contract Administration	x	x	x
Review and consolidate budgets and performance schedules	x	x	x
Approve changes to designs, schedules, funding allocations, and commitments to completion dates	x	x	x
Develop and implement a control system to evaluate costs, performance schedule, and technical performance of the contractors	x	x	x
Maintain technical overview of Project activities via periodic meetings, reviews, Project reports, and other means to assure that the Project objectives are being effectively met	x		x
Review and approve the designs of surface and underground facilities, and waste handling equipment to meet the programmatic objectives of the Project	x	x	x
Assure that plans contain the requirement to implement the appropriate DOE-approved procedures for safety, security, and maintenance	x		
Establish a quality assurance plan and insure proper implementation by all Project participants	x	x	
Ensure preparation of environmental assessments		x	x
Provide technical and administrative assistance to headquarters			x
Establish advisory groups or arrange for the services of consultants as appropriate	x	x	x
Provide support in the preparation and implementation of a Public Affairs Plan	x		
Interact with the NRC on licensing requirements with the concurrence of headquarters	x		
Conduct interactions with other government agencies, state and federal, after coordination w/headquarters	*	*	
Purchase (or condemn) leases to protect integrity of site	N/A	N/A	

* These activities are neither delegated to the Field nor reserved by Headquarters.

Table 5

HEADQUARTERS RESERVED AUTHORITIES

Responsibility	Nevada	Richland (BWIP)	Columbus (NWTs)
Establish and provide overall policy and program guidance	x	x	x
Monitor the performance of field office and contractors and provide direction and guidance as appropriate		x	x
Review program goals proposed by field and contractor; concur in and provide final approval of an integrated program plan for meeting those goals, including changes thereto	x	x	x
Approve major program and facility initiatives	x *	x	x
Approve general site, facility, and waste form criteria	x	x	x
Approve overall licensing, planning, and strategy for major waste facilities		x	x
Maintain cognizance of executive, legislative, and regulatory policies and advise field of such policies	x		x
Coordinate all public affairs and state interactions			x
Liaison at national level	N/A	N/A	x
Review and approve environmental and safety documents	x	x	
Resolve differences among field organizations			
Approve budget levels	(x)	(x)	(x)

* The Management Charter for Nevada lists only the following specific major initiatives: utilization of spent reactor fuel, selection of AE and operating contractors, decision to start construction, test operations and start production phases.

** The Management Charter for WIPP lists similar major initiatives as does the Nevada Charter.

(x) = reserved authority implied.

states. Since the Nevada and Richland activities are fully contained within the host state, the interactions are more easily undertaken.

The program charters reflect only formal guidance. Informal guidance is also a factor in analyzing delegations of authority. Discussions were held with responsible headquarters and Field officials to try to understand the informal delegations. These discussions verified for the most part the formal delegations with two important exceptions:

1. The Columbus organization undertakes significant interaction with other federal agencies and with state officials. Activities with states emphasize education programs and technical information exchange. These activities are always coordinated with headquarters but usually not conducted by headquarters.
2. The Field offices are powerful organizations which have a lot of freedom to initiate or conduct interactions and institutional arrangements within their areas of activity.

Thus, discussions with Field officials confirmed the emphasis of the formal documentation that

1. interactions with non-DOE actors emphasize those considered necessary to allow site investigation to continue; and
2. most interactions with non-DOE actors are initiated and conducted on a case-by-case basis by Field organizations (or contractors under the direction of the Field) which are in many ways independent of headquarters staff.

Staffing

No compilation of staff by experience or education was available,[2] but discussions with headquarters and Field officials identified technical DOE staff capabilities primarily in engineering and earth sciences. The experience and expertise brought to bear is federal R&D management, facility operation, or facility and system design. The majority of staff effort is devoted to guiding and monitoring contractors. The reasons for this are fairly straightforward and result from the dependence on small staffs to administer large contracts.

Reliance for non-technical inputs and sensitivities is placed outside the DOE with contractors or advisory groups. "Through the ONWI organization [contractor to the Columbus Program Office], social scientists provide . . . input to the program." [3] In addition, DOE and its prime contractors are making use of technical peer review and advisory groups to provide diverse expertise and perspectives to supplement the sensitivities of the DOE technical program.

REQUIRED CAPABILITIES--CONCEPTUAL FRAMEWORK

Implementation Process

Consistent with the analysis of Section III, an implementation process for HLW disposal has three basic elements: (1) information gathering and strategic planning, (2) negotiation, and (3) operational activities. The first two elements are examined in detail in Section

[2] Time constraints prohibited compiling one for this study.

[3] DOE/NE-0007, Supp. 1, p. II-27.

III. Operational activities consist of the day-to-day administrative, professional, and technical activities required to establish a repository. In the case of HLW disposal, operational actions are largely non-repetitive tasks involving site characterization, design and construction, and so on. In many cases they are activities designed to resolve technical uncertainties and develop technical capabilities. Many are R&D activities which involve scientific testing and verification. Although the results of R&D must be fed back into the strategic planning element, operational activities do not include the formulation, interpretation, or extrapolation of policy.

The implementation process is iterative. The results of operational activities affect both the interests of other actors and the feasible technical alternatives. They therefore provide input to information gathering, strategic planning and negotiation.

DOE's ability to carry out these three classes of activity depends on the following conditions:

- o adequate legislative authority to carry out the mission;
- o clearly assigned responsibility for the necessary planning and implementation activities; and
- o staff with appropriate experience and training.

Statutory Authority

First, the DOE must have adequate statutory authority to plan for and conduct the activities necessary for successful implementation. If, for example, the DOE does not have statutory authority to perform necessary research and development, to bank qualified sites, or to

mitigate environmental impacts, a repository cannot be established. We examined program documents in order to identify those areas where DOE has clear statutory authority to perform necessary implementation actions. For example, the DOE FY80-FY84 multiple year plan for commercial waste management was based on specific legislative mandates to take particular actions; DOE did not plan for activities where explicit authority did not exist.[4] Where program documents did not indicate whether appropriate authorization exists, we asked waste management officials during interviews whether the DOE had authority to take the actions necessary for implementation.

Assigned Responsibility

Second, responsibility for an activity must be assigned within the DOE in order for it to occur. The HLW program (along with other governmental programs) is required to allocate scarce resources (funds and manpower) among alternative uses. The assignment of responsibility places a task on an organization's agenda. Whether the task actually gets accomplished depends on (a) how many other things the organization has responsibility for and what importance the larger organization places on the task, (b) what the leadership's performance is evaluated on (system of incentives), and (c) the resources made available to accomplish the task. Establishing that a task needs to be performed is often much more difficult than performing it.[5] Once an item has been

[4] The "Commercial Waste Management Multi-Year Program, FY-1980" states (p. 48) that legislation recommended by the IRG but not yet passed by Congress is not included in the plan. It then lists the areas of potential new legislation.

[5] K. J. Arrow, The Limits of Organization, 1974, W. W. Norton & Co., New York.

placed on the agenda "it is difficult not to treat it in a somewhat rational manner. . .and almost any considered solution may be better than neglect." [6] Since the assignment of responsibility is a necessary condition, if responsibility for an activity is not clearly assigned within the DOE, the activity will probably not be performed.

In order to judge whether the responsibility for implementation activities had been assigned within the waste management staff we relied primarily on our review of program documents. Secondly, when interviewing officials we asked whether needed actions were within their responsibility and, if not, whether other officials within the organization had been assigned responsibility. For activities involving strategic planning, we looked specifically for the identification of a range of alternatives or of the interests of other actors as indication that strategic planning was ongoing.

We assert that strategic planning and negotiations should be carried out directly by the DOE. The HLW program was established to protect public health and safety and is carried out for the public good. Because these strategic activities determine the success of the program and impose costs or confer benefits on other actors, they should be carried out by public officials. Secondly, the assignment of responsibility directly to DOE staff helps assure the proper organizational incentives, priorities, and resources for task completion. With appropriate DOE guidance, tasks in support of information gathering, planning and negotiations, as well as operational tasks, may be carried out by contractors.

[6] Arrow, pp. 47-48.

Appropriate Staff Capabilities

Third, implementation depends upon the existence of staff trained and interested in performing the activities required. HLW disposal requires staff capabilities for information gathering, strategic planning and negotiation (in addition to technical staff expertise required to perform technology development and site characterization).

The discipline of a staff member in combination with the individual's experience "affect all parts of the problem solving process including problem definition, consideration of alternatives, the treatment of constraints, and analysis and evaluation." [7] Every discipline brings with it a set of procedures for problem solving appropriate to one subset of problems. [8] The discipline creates the framework for an expert's perspective and may explicitly promote value judgments. It implies dependence upon the past experiences of the profession (and of the individual who usually works on problems appropriate to the profession) and dependence upon models of complex processes and relationships which direct the expert's work toward suitable solutions. For example, the training and experience of engineers is more appropriate for problems that can be treated as constrained optimizations than for policy problems subject to a diverse set of policy preferences and acceptable outcomes.

[7] Jonathan Weiss and Richard de Neufville, "The Role of Experts in Airport Planning: A Study of Professional Paradigms," Intercollegiate Case Clearinghouse, Boston, Massachusetts, 1979, p. 14.

[8] See Weiss and de Neufville and Thomas S. Kuhn, The Structure of Scientific Revolutions, The University of Chicago Press, 1970, Chapter V.

Given the importance of training and experience, the next question is what type of background is appropriate for strategic management. This is not an easy question to answer. Professor Bower, in considering the need for strategic management in the firm, simply states the staffing requirements as "the need for generalists." [9] He is referring to individuals not constrained by one or two paradigms or approaches to problem solving. Such individuals might include technical or non-technical persons with broad experience in the law, political conflict resolution, arbitration, or the management of large industrial facilities. Individuals participating in the development and siting of controversial facilities which have significant private and intergovernmental interfaces (e.g., prisons, sewage treatment plants, and electric generating plants) might provide useful skills and knowledge.

ASSESSMENT OF EXISTING DOE CAPABILITIES

We assessed the strengths and weaknesses of the current DOE HLW program (again using siting as an illustrative system component) according to the conceptual framework described above. Table 6 shows the result of that assessment. The needed actions on the left-hand side of the table are taken from the path of needed actions developed in Section II (see Figure 2). The right-hand side capabilities are evaluated according to the conditions required for implementation:

[9] Joseph L. Bower, Managing the Resource Allocation Process, Richard D. Irwin, Inc., 1972, p. 319.

Table 6

(pg. 1 of 3)

ONWH CAPABILITIES TO IMPLEMENT HLW PROGRAM
SITING

Implementation Process (Needed Actions)			Implementation Capability		
Strategic Activities		Operational Activities	Statutory Authority	Assigned Responsibility ¹	Current Reliance on DOE or Contractor ²
Policy Planning	Negotiation				
• (DOE) Develop comprehensive procedures for initial property bracketing and land acquisition			YES	No	Contractor
		• (DOE) Initial property bracketing	YES	Ad hoc	DOE/ Contractor
		• (DOE) Detailed property acquisition	?	Ad hoc	?
• (DOE) Develop non-technical site selection criteria			YES	No	Contractor
• (DOE) Determine how sites will be eliminated and compared			YES	No	?
	• (DOE) Reach consensus with SPC on site selection and elimination criteria		YES	No ³	?
	• (DOE) Reach consensus with SPC on regional siting policy		YES	No ³	?
• (DOE) Develop parameters for preferred policy and stages for consultation and concurrence and for technical and financial assistance to states			YES	YES	DOE/ Contractor
• (DOE) Assess abilities and authorities of states to impact siting			YES	No	Contractor
	• (DOE) Negotiate consultation and concurrence with specific states		YES	Ad hoc	DOE/ Contractor
	• (DOE) Reach consensus with SPC on procedures for consultation and concurrence		YES	No ³	?
	• (DOE) Reach consensus with state on procedures and policies for technical and financial assistance		YES	Ad hoc	DOE/ Contractor

NOTE: See end of table for key and notes.

Table 6--continued

(pg. 2 of 3)

Implementation Process (Needed Actions)			Implementation Capability		
Strategic Activities		Operational Activities	Statutory Authority	Assigned Responsi- bility ¹	Current Reliance on DOE or Contractor ²
Policy Planning	Negotiation				
• Assign lead responsibility within DOE for concurrence on USGS geologic characterization activities			YES	YES	?
	• Reach agreement with USGS on procedures for start up of investigations within a state		YES	No	?
		• (DOE) Establish technical site selection criteria	YES	YES	DOE
		• (DOE) Select geologies to characterize	YES	YES	DOE
		• (DOE) Develop geologic analytic models	YES	YES	DOE
		• (DOE) Select site areas to characterize	YES	YES	DOE
		• (DOE) Identify uncertainties	YES	YES	?
• (DOE) Identify how uncertainties will be resolved			YES	YES	DOE
		• (DOE) Perform needed in-situ treating and other R&D	YES	YES	DOE
		• (DOE) Characterize sites	YES	YES	DOE/Contractor
		• (DOE) Assess sites - performance - site suitability - environmental impacts - socioeconomic impacts	YES	YES	DOE/ Contractor

NOTE: See end of table for key and notes.

Table 6--continued

(pg. 3 of 3)

Implementation Process (Needed Actions)			Implementation Capability		
Strategic Activities		Operational Activities	Statutory Authority	Assigned Responsi- bility ¹	Current Reliance on DOE or Contractor ²
Policy Planning	Negotiation				
• Investigate DOE and inter- agency options for compen- sation			YES	No	Contractor
• Develop policy on compen- sation and incentives to states			YES/ No ⁴	No	Contractor
	• (DOE) Negotiate Compensation and incentives with specific states		YES ⁴	Ad hoc	?
	• (DOE) Reach consensus with SPC on policy and procedures for compensation		YES	No ³	?
		• Bank qualified sites	YES	Ad hoc	?
• (DOE) Compare sites			YES	?	?
	• (DOE) Select site(s)		YES	?	?

Key: Ad hoc -- means that these activities are carried out in a case specific manner by different officials without policy guidance.

? -- means evidence was not found to support any conclusion.

NOTE: [1] Considered assignment within DOE only.

[2] We considered whether primary reliance was placed in-house or with contractors to conceptualize and lead activities.

[3] Staff has been assigned as general support for a liaison with the SPC.

[4] No authority for providing incentives has been identified. Authority to compensate communities for many socioeconomic impacts exists.

1. Statutory authority--Is it present or absent for each of the required activities?
2. Assigned responsibility--Is responsibility for an action clearly assigned to a DOE management official? If the activity is a negotiation activity or operational activity, has requisite strategic planning been clearly assigned or is the negotiation carried out in a case specific or ad hoc manner without policy guidance?
3. Is the DOE relying on contractor staff or in-house capability to conceptualize, initiate and lead implementation activities?

The results are summarized as follows.

Statutory Authority

Statutory authority appears to exist in all areas except in the area of providing economic incentives to the states.[10] In other words, current statutory authority might not provide DOE the range of alternatives necessary to satisfy the equity concerns of potential host communities. DOE has recognized this limitation. It is important to understand the distribution of benefits and costs of a repository in order to assess the likelihood and intensity of state and local opposition, which in turn will determine the nature of exercise of available policy leverage. The ability of the DOE to offer incentives or compensation, and the types of packages of compensation or incentives, will affect the balance of risks and costs and is a vital

[10] Of course, authorizing and/or appropriations legislation might be needed for specific tasks such as land acquisition.

tool in the negotiating necessary to establish a site. This is, therefore, an area where clear positive statutory authority is desirable.

Assigned Responsibility

The assignment of responsibility to conduct the operational activities (e.g., establishing technical site selection criteria and developing geologic analytic models) is clear and has resulted in detailed program efforts to conduct such activities.

Responsibilities have not been fully assigned to assure that necessary strategic planning and negotiation are performed. For policy planning, we could find no clear assignment of responsibility for such tasks as developing procedures for property bracketing and land acquisition, developing non-technical site selection criteria or determining how sites will be eliminated and compared. Moreover, in many cases, responsibility to engage in negotiation or operational activities is assigned and carried out in a case-by-case fashion without the benefit of policy guidance. More explicit attention to monitoring the environment and to strategic planning would enhance the ability of the DOE to anticipate controversy, to identify a range of alternatives which will satisfy the interests of other actors, and to conduct and implement negotiation. The incremental nature of decisionmaking that results is likely to lead to non-uniform, unanticipated, and potentially undesirable policy outcomes.

DOE often has been relying on contractor personnel to identify and analyze institutional and socioeconomic issues and to conceptualize or

initiate responsive action. Such delegation can create problems for the program. Contractors can provide valuable monitoring functions and can assist in problem or issue definition; but they should, at most, only make recommendations for action. They should not be placed in a situation where they effectively set policy precedents. Primary responsibility for strategic planning and negotiation must be assigned in-house. Where responsibility for a task has not been assigned within the DOE staff, appropriate guidance to and monitoring of the contractor will not be forthcoming. The assignment of responsibility in-house will help establish appropriate priorities, incentives, and resources for these tasks.

Staff Capabilities

Although staff capabilities are not evaluated in Table 6, our review of program documents and interviews leads us to the clear impression that staff needs expansion and upgrading to deal effectively with these institutional issues. This is not to denigrate existing staff, who generally are performing well the tasks assigned to them. Staff competence is very difficult to assess. Our review, however, suggests that higher priority should be given to strategic planning and conflict resolution, activities that will require a different skills mix from technical analysis and operations.

There is no "cookbook recipe" for staffing the HLW program with an appropriate mix of attorneys, negotiators, "generalists" and other professionals to perform the planning and negotiating functions. But we do believe that the HLW program managers should seek individuals with a

broader range of backgrounds and skills to complement the current largely technically trained staff.

The goal is to provide an organizational environment and staff for what we have termed strategic management. Qualities observed in strategically managed organizations include[11]

1. Task-oriented organizational flexibility accomplished through interdisciplinary teamwork.[12]
2. The commitment to make things happen, including the acceptance of tradeoffs in efficiency or cost.
3. A shared belief that the organization can largely create its own future. For the HLW program, this means a belief that the DOE can and should create institutional arrangements that will satisfy the interests of critical actors sufficiently to permit repository siting, development, and operation.

[11] Gluck et al., pp. 160-161.

[12] Gluck notes that reliance on teamwork will also lead to ambiguity but that such ambiguity can be managed and is a worthwhile tradeoff for the benefits of a variety of views applied to problem solving.

V. CONCLUSIONS AND RECOMMENDATIONS

Our major thesis is that the sharing of authority among DOE and other actors drives the consideration of institutional arrangements in implementing an HLW disposal program. This derives from

- the frequency of shared decision points,
- the nature of potential costs imposed or benefits conferred on other actors which makes implementation processes and decisions important to them, and
- the level of uncertainty concerning the magnitude and specifics of these potential costs and benefits.

As a result of these three realities, the mechanisms for involving other actors in the decisions and processes for decisionmaking are of great importance to the successful development and operation of an HLW repository. It is important that institutional arrangements and procedures be established that will satisfy the interests of critical actors sufficiently to permit repository siting and operation.

Section II and the material contained in the Appendixes illustrate the range of tasks facing DOE program managers. Numerous consultations with diverse actors outside DOE must take place to even characterize important aspects of program implementation. Program plans must be formulated with an appreciation of the likely responses of these actors. In some instances, Congressional concurrence may be required, either directly in the form of authorizing legislation or through appropriations of funds necessary to implement plans. Throughout the

implementation of the program, DOE must be able to alter its plans to reflect new information concerning technologies for storing HLW, demands for storage capacity, attitudes and actions of critical actors, and instructions from Congress or the Secretary. As developed more thoroughly in Section III, we believe that this ability requires a form of continuing planning and program implementation that we term strategic management.

Strategic management is a dynamic style of management which permits the DOE to set and modify program objectives in light of the overall goals of the program and the changing interests and powers of influence of non-DOE actors. We suggest that it requires three fundamental classes of activity:

1. Gathering information concerning the external environment within which DOE must operate (the actors, their interests and stakes, their manner of bargaining, and likely bargaining objectives) as well as estimates of likely changes in that environment.
2. Strategic planning, which formulates objectives and delineates alternative actions for the program in light of its overall goals and the information that is gathered about other interests involved.
3. Bargaining and negotiation to reach accommodations with these outside actors that further program goals.

These are continuing activities. Strategic planning must respond to the input of new information concerning the environment in which the

HLW program operates as well as the needs of the negotiators. The negotiations themselves will provide information that will lead to revised plans. Strategic management requires more than a single plan developed at the beginning of the implementation of a program. It is the development and continuing modification of such plans to reflect the changing environment in which implementation takes place.

In Section IV we suggested a number of reasons why the HLW program in its current form is likely to have difficulties with strategic management. The HLW program organization is complex with a mixture of centralized and decentralized elements that are the product of many years of program history. Both tradition and the realities of personnel allocations have led the program to rely heavily on contractors to perform important program tasks, including in some instances strategic planning and negotiation. The program itself has traditionally and consciously emphasized research and development activities, and the contractor organizations as well as the DOE program staff have the training and experience appropriate for such activities. As the program moves into the new environment that we have described, personnel with new types of training and experience are required but who, in general, do not yet seem to be an important part of the program staff. In the absence of such experience, it has been difficult to develop the plans and strategies that would facilitate the assignment of clear responsibilities for dealing with the institutional issues that we have identified. Our investigations suggest that such is the case.

The problem of implementing the concept of strategic management is not just the problem of getting an existing organization with strong

traditions and in-place competencies to adopt new ways. In many ways the concept is incompatible with the manner in which we run our government. We suggested in the last section that strategically managed organizations were characterized by three qualities:

- o they are task oriented with the flexibility to consider a wide range of options developed through interdisciplinary teamwork;
- o they are committed to making things happen and are willing to accept decreased efficiency or higher cost in doing so;
- o their staffs share a belief that the organization can largely create its own future.

Government organizations are frequently limited in the degree to which these qualities can be achieved. For example, the elaborate processes that have developed to permit the participation of legitimate interests in the development of policies or budgets often seem to divert the organization's attention from tasks to be achieved to the process itself. Despite strong commitment, it is extraordinarily difficult to make things happen in the face of all the checks and balances that are a part of the public sector. Maintaining a staff's faith that an organizational unit four levels down in a frequently beleaguered Department can create its own future may be beyond the capacity of even the most skilled public servant.

The fact that strategic management may be difficult to achieve in a public bureaucracy does not lessen its importance to the success of the HLW program. DOE faces a real quandary. Our analysis suggests that important changes are required in the content and conduct of the HLW

program to deal with institutional issues. To achieve these changes we believe that a management style with the important elements of what we term strategic management must be adopted.

We recommend that DOE carry out a major study of needed changes in the HLW program. This study should consider the following issues:

- o The adequacy of the current HLW organizational structure for dealing with the implementation of complex and controversial institutional arrangements in a continually changing environment (e.g., the distribution of responsibility among headquarters and the field).
- o Whether the current location of the HLW program within the larger DOE organization will permit it to successfully carry out the negotiations necessary to achieve its mission.
- o What strategic or planning activities are required to guide the HLW program and where they should be located within the organization.
- o The adequacy of the current experience and skill mix of civil service staff to perform the strategic planning and negotiations (internal and external) required for implementation.
- o The adequacy of DOE policy regarding the tasks to be performed by contractors with regard to the establishment of institutional arrangements or negotiations with important actors.

This Note provides a starting point for some elements of the study we recommend; but many other concerns and interests, beyond our

capabilities to bring to bear, might also be reflected in the charter for such a study. Because our analysis suggests that important changes are required in the content and conduct of the HLW program, we suggest that the study should probably be conducted under the leadership of the Under Secretary in his capacity of overseeing DOE's outlay programs.

APPENDIX A

INSTITUTIONAL AND IMPLEMENTATION ANALYSIS OF HLW TRANSPORTATION

This appendix evaluates the institutional framework for transportation. It examines who the actors are, the status of their authority, and the points of controversy between DOE and other actors. The actions required to implement the transportation program were identified considering constraints imposed by the distribution of authority, procedural requirements, and points of controversy.

INSTITUTIONAL FRAMEWORK

Actors and Responsibilities[1]

Department of Transportation (DOT). DOT regulates the safety aspects of transportation of hazardous materials in interstate and foreign commerce by land, on civil aircraft by air, and on other than public vessels (i.e., those operated by public agencies) in navigable waters. DOT includes the Federal Highway Administration (FHWA), which regulates safety in transport by truck, bus, taxi, or other vehicular transport; the Federal Railroad Administration (FRA), which regulates safety in transport by rail; the Federal Aviation Administration (FAA), which regulates safety in transport by civil aircraft; the U.S. Coast Guard, which regulates safety in transport by water; and the Materials Transportation Bureau (MTB), which promulgates the safety regulations

[1] The regulatory responsibilities are taken in part from NUREG-0179. Regulatory and Other Responsibilities as Related to Transportation Accidents, Nuclear Regulatory Commission, June 1977.

for the above DOT agencies. Water transport by other than public vessels in navigable waters is regulated by the U.S. Coast Guard. Vessels carrying more than 12 or 16 passengers, cargo vessels, and barges are included.

On January 31, 1980, DOT issued a notice of proposed rulemaking on highway routing of Radioactive Material (45 FR 7140).[2] If this proposed rule is enacted, shippers of large quantity packages of radioactive material would be required to file with MTB a route plan within 90 days. Carriers of any radioactive material requiring placarding shall use routes that

risk radiological exposure to the fewest persons, considering time of day and day of week during which transportation will occur, population density and activities, effectiveness of local emergency planning, terrain and physical features, and weather conditions.

In addition, those carrying large quantity packages shall operate over "preferred highways"--any interstate highway not disapproved by a state. A state is given authority to designate preferred highways or disapprove interstate highways as preferred. A state in so designating must try to minimize travel time. A state cannot prohibit travel between two points, impose restrictions based on time of day (unless a substitute highway is designated) or require prenotification, escort, or special equipment. A carrier of large quantity radioactive material must provide the driver and shipper a written route plan before departure.

[2] The final rule was published on January 19, 1981 as this Note went to printing. See 46 FR 5297. We did not hold up publication to compare the final rule with the proposed rule.

The rule has not been made final. Once it, or a revised version, becomes final the legal authority of the states will become more limited than at present.

Nuclear Regulatory Commission (NRC). NRC regulates persons who possess, use, or transfer (including transport) radioactive materials that are by-product, source, or special nuclear material. 10 CFR Part 71, "Packaging of Radioactive Material for Transport and Transportation of Radioactive Material Under Certain Conditions," specifically applies to shippers (those who prepare and deliver packages to a carrier for transport and private carriers of such materials; in the latter case, the carrier has both possession of and effective control over the material during transportation.

The NRC and DOT responsibilities directly overlap for regulation of safety in the transport of source, by-product and special nuclear material. The agencies entered into a memorandum of understanding in 1973 which was revised in 1979. Under the agreement NRC develops standards and regulates package design and performance for fissile material, Type B[3], and large quantities of radioactive materials. NRC also establishes regulations for physical security against terrorist and other deliberate acts. DOT develops standards and regulates package design and performance for Type A materials and for the mechanical conditions of carrier equipment and qualifications of carrier personnel, carrier loading, routing, unloading, handling and storage of radioactive

[3] Type A and B quantities depend upon the form of the material and the activity. Type A quantities are less hazardous than Type B quantities. Radioactive wastes going to a HEW repository will fall under the packaging jurisdiction of the NRC.

material. In other words, NRC certifies packages and is responsible for physical security and DOT regulates the actual transport. The agencies enforce their own regulations. [In addition, many states have adopted and enforce DOT regulations.]

On June 15, 1979, NRC established interim physical security rules (44 FR 34466) for transport of spent fuel. Those rules require advance notice to the NRC of shipment, advance arrangements with law enforcement agencies, use of routes to avoid heavily populated areas, a trained escort, and other security measures. DOT proposes to require identical provisions in their rule on highway routing to apply to DOE, which is exempt from NRC regulations. It would also exempt such shipments from the highway routing rule if the provisions of the DOT rule conflicted with the NRC security requirements. DOE opposes these regulations.

The Interstate Commerce Commission (ICC). ICC regulates the economic aspects (rate schedules, tariffs, etc.) of transportation of goods, both hazardous and nonhazardous, in interstate and foreign commerce by land, i.e., by truck or rail, and by barge on inland waterways. The Federal Maritime Commission (FMC) regulates the economic aspects of ocean transport. Basically, the ICC and the FMC regulate carriers. The ICC regulations define three types of carriers: private carriers, who transport their own goods; contract carriers, who selectively transport other people's goods under specific contracts; and common carriers, who transport goods for the general public in accordance with certificates of public convenience and necessity issued by the ICC. Those for-hire common or contract carriers who operate solely within a state and who are not subject to ICC regulations because

they are not operating in interstate or foreign commerce are normally subject to "certification" or "permit" requirements of the state within which they operate.

During 1977 and 1978, the ICC issued several rulings at the request of shippers filed in response to rail carriers' attempts to require that HLW be consigned to special trains or be "flagged out" in that no set tariff would be in effect.[4] The issue is also an economic one--any accident involving radioactive material, whether or not a release occurs, will likely result in disruption of service. Disruption of service on a rail line results in a major economic loss due to the lack of alternative lines. In the event of a release of material the disruption may last days. The ICC ruled that special trains were not required based on economic considerations. It found that DOT or NRC would have to rule on the safety aspects. The issue has not been brought before the DOT or NRC.

State/Local Governments. The Hazardous Materials Transportation Act does not restrict state and local governments from adopting ordinances which restrict or otherwise affect transportation of hazardous materials if such rules are not inconsistent with DOT regulations. There has been a proliferation of state and local restrictions. In response to a ban on transport of spent fuel through New York City adopted by the city in 1976, DOT immediately began a rulemaking to consider highway routing of nuclear materials. The New York City Ban plus most other restrictions (e.g., those requiring prenotification or escort, those which would prohibit transport through

[4] ICC docket Nos. 36312. 36307. and 36325.

the state, or those imposed by local jurisdictions) would be invalidated by the proposed DOT highway routing rule if enacted.

Among responsibilities or controls which clearly belong to state or local government are:[5]

- o Permission to construct railroad spur lines over land owned by others;
- o Permission to construct power lines (needed to serve waste facilities) across highways or other state property;
- o Weight limits for highway vehicles and systems.

Department of Energy (DOE). DOE has ultimate responsibility for development and operation of an HLW Repository. One element of a repository is the transport system. DOE has responsibility for safety, efficiency, quality control, and so on. DOE is exempt from NRC regulations but consults with NRC on packaging. DOE is not exempt from DOT regulations but DOT exercises no enforcement of DOE or DOE contractors. Lacking jurisdiction, no enforcement by NRC can take place. DOE also has the option of acting as the shipper, carrier, or both for waste shipments to an HLW repository as well as to and from a federal AFR. DOE currently acts as shipper and often as carrier for transport of defense TRU wastes and weapons components deliveries and transport.

DOE is responsible for designing shipping containers for DOE waste and in the final analysis for assuring the adequacy of transportation systems to a repository.

[5] Randall F. Smith, Federal-State Relationships in Nuclear Waste Management, Draft, B-HARC-311-027, Battelle Human Affairs Research Centers, Seattle, Washington, 1979, p. 16.

Other federal actors. Important elements of the institutional framework not analyzed here include:

- Department of Interior - Bureau of Indian Affairs - controls movement of nuclear materials across tribal lands affecting I-40, I-25, I-80, I-70, and other interstates;
- Federal task forces including the State Planning Council and the Radiation Policy Council; and
- Congressional committees with oversight, appropriations, or authorization authority over transportation.

Industry. Normally it is the responsibility of the transportation industry (carriers) and the nuclear industry (shippers) to design, build, and operate hardware for transport of commercial radioactive materials. Spent Fuel casks for transshipment of irradiated fuel are available, but inadequate hardware exists for shipment of wastes to a repository or large scale shipment of spent fuel to AFRS. Because DOE has announced its intention to provide casks and services if the need arises[6], and due to other uncertainties, private industry has not risked investment in additional transportation hardware.

Points of Controversy

Consideration of the unresolved issues in nuclear waste transportation lends an important base for identifying decisions and actions necessary for program implementation.

[6] DOE/NE-0007, Supp. 1, p. II-161.

- o DOE will be a major shipper of spent fuel and will be the only shipper of defense HLW and TRU. DOE has authority to also act as carrier and currently acts as a carrier for weapons shipments and shipments of TRU. DOE has not yet determined 1) whether they will act as carrier, 2) when the decision will be made, or 3) on what criteria or under what circumstances they will decide. The existing climate is one of uncertainty. Major elements of the transportation system such as the kind and form of waste to be transported, the timing of a repository, whether AFR's will be constructed, the role of DOE, the nature and coverage of liability protection, and so on are undefined. DOE is developing capability to provide transportation services in case of failure by industry to enter into competition. In light of these conditions, industry has not been convinced of the profitability of entry into this field and has failed to make significant investments.
- o Liability--The DOE is confident that the Price-Anderson Act provides comprehensive coverage for waste transport.[7] Yet concern about the adequacy of current liability coverage for transportation is raised repeatedly during public meetings and hearings on waste siting and transportation. Of specific concern are: theft or diversion of material, evacuation of residents when release doesn't occur, and contamination of rail

[7] See, for example, "The System of Insurance and Indemnity Coverage for Public Liability Associated with Nuclear Materials in the Course of Transportation in the U.S.," Omer F. Brown, II, Office of the General Counsel, DOE, November 13, 1980.

equipment resulting in major disruption of service.

- o Physical Security--Some consider the shipment of spent fuel a likely target for sabotage either as a threat to public health and safety or to divert the fuel for use in building nuclear weapons. NRC recently enacted regulations for safeguarding shipments of spent fuel. DOE is exempt from such regulations, but the proposed DOT highway routing rule might bring them in compliance. The adequacy of such measures and whether equivalent measures are required for HLW and TRU are still questioned. DOE opposes the measures as being counterproductive.
- o Routing--There have been numerous attempts by state and local governments to restrict shipment of radioactive materials. A ban on transport of spent fuel imposed by the city of New York prompted a DOE rulemaking to consider the highway routing of nuclear materials in more detail. That rule, if enacted in its present form, would invalidate the New York City ban and most other state and local statutes proposed or enacted (see discussion above). The rule will likely be controversial since it appears to reduce the authority of state and local governments. DOE must take the initiative to establish cooperative interactions.
- o Availability of Carriers--the DOE plans to transport over 50% of the HLW to a repository by rail, yet the railroads have balked at carrying radioactive materials and have proposed use of special tariffs and special trains with speed and other

operating restrictions. The ICC ruled that since the DOT and NRC regulated safety of hazardous materials transport, the rail lines had to be consistent with DOT and NRC regulations. The rail carriers have continued to raise these issues in public forums[8] but have not requested DOT or NRC action. Among the concerns which led the rail lines to request special rules are safety, liability and the potential for interruption of service as the result of needed clean-up of radioactive spills.

- o Mode(s) of Transportation--Although the railroads have been reluctant to transport radioactive waste and spent fuel, the trucking industry has generally been enthusiastic. The mix of transportation modes must be determined in order to plan the design and construction of casks and other hardware in a timely fashion. Trade-offs will be required regarding 1) the time in transport--highway is generally faster than rail, 2) carrying capacity--rail casks can carry more fuel assemblies, 3) the number of shipments, 4) economic and other cost considerations and 5) the availability of carriers.
- o Availability of necessary transportation hardware and packages--It takes five to eight years to design, certify and construct shipping casks.[9] Adequate capacity does not currently exist for shipments to a repository. Resolution of other outstanding issues such as siting, waste to be shipped

[8] Proceedings of the Nuclear Materials Transportation Program Development Seminar, held April 1979, TTC/003P, Sandia Laboratories, Albuquerque, New Mexico.

[9] TTC/003P.

and waste form, the mix of transportation modes, timing of the repository, and availability of carriers hinders development of a logistics system. Private industry will not invest until these issues are resolved. In the absence of private investment DOE will need to develop the elements of a transport network.

- o Health and Safety--the radiologic dose commitment from transportation has been questioned on several grounds: (1) unacceptably large dose commitments to a select group resulting from large numbers of waste shipments along a single or few transportation corridors, (2) the adequacy of package designs in normal transport and during accident conditions, and (3) the adequacy of NRC, DOT and State enforcement of regulations. Notwithstanding these concerns, the safety record of nuclear transport is exceptional and NRC, DOT, and DOE studies show risk well within limits acceptable for other industries.
- o Emergency Preparedness--currently, the first line responsibility to respond to accidents rests with local and state authorities just as it does for all other transportation incidents. These officials possess varying capability to respond in a radiologic emergency. The Federal Emergency Preparedness Agency (FEMA) has lead federal responsibility for radiological incident emergency response planning, training and other assistance activities outside the fence of a nuclear facility and is developing guidance for state and local governments. NRC, EPA, DOE, DOT, HEW, DCPA, and FDAA play

contributing roles but the actual work of first-aid, public safety, and cleanup is shared by the state and local authorities and the carrier. Clean-up can be hindered by the difficulty in hiring workers to clean up radioactive spills. The shipper has ultimate financial responsibility. The effectiveness of emergency response capabilities, the need for better planning and training, and the proper division of clean-up responsibility is at issue for all nuclear materials transportation.

- o The evaluation of transportation risks and issues must play a role in DOE site selection. Many are concerned that such issues are receiving inadequate attention in the siting decision.
- o NRC must determine how the transportation system and risks will be evaluated in repository licensing. No investigation is underway to consider whether programs or procedures in addition to those currently employed for other nuclear facility siting are required.
- o The division of authority between the federal government and state governments can be viewed as an issue separate from the issues of routing and emergency response. Transportation has the potential to directly affect non-host repository states and has been recommended as an issue to be addressed by the State Planning Council established by President Carter. In addition, the role of states in enforcement is still developing.

- o Interagency coordination and cooperation may be one of the most difficult issues to resolve. The responsible agencies believe that current coordination is adequate yet the public, the states, the industry, and even staff members of the agencies view the federal effort as extremely fragmented. The agency missions and priorities are quite different and in combination with territorial protectionism make cooperation difficult.

The points of controversy lead to identification of actions and decisions required of DOE to resolve the controversies. Some of the actions which can be identified are:

- o Establish DOE policy on emergency response programs--this involves diverse considerations. First there is the need to meet regulatory requirements and to go beyond requirements if cost-effective improvements to protect public health and safety are available. The DOE Operations Offices are well in position to do this. But in addition, locale-specific training and response programs may be a useful tool in bargaining with states and local governments to resolve concerns of equity or safety. When the idea of the use of training and response programs for reasons other than to increase safety was broached with a field manager the response was that public funds should not be used unless a clear increase in protection could be demonstrated and that he had no authority to take action except to further safety. DOE must decide the extent it can and will provide emergency response programs and how funding will be

provided. Such funds might be calculated as part of the fee charged utilities. The timing of and responsibility (Field or headquarters) for such local negotiations must also be determined.

- o Reach consensus with state on road/rail improvements--DOE/state agreements on providing road or rail maintenance and improvements in support of reliable transportation might be one mechanism to satisfy equity and safety concerns of state and local governments.
- o Develop DOE position on desired industry participation and assess obstacles to participation--the Transportation Technology Center at Sandia is conducting workshops with transportation suppliers and carriers. This activity is not supported by DOE policy guidance regarding actions DOE might take beyond confirming items in the DOE program or trying to reduce scheduling uncertainties and the like. A policy position on desired industry participation will depend upon a sophisticated economic and legal analysis of the industry's capabilities and interests. The policy will have to include an identification and evaluation of activities that could be taken to assure the desired level of participation. Activities to be considered might range from agreeing to pay special tariffs and speeding up criteria development or procurement to proposing new liability arrangements.
- o Negotiate with carriers to determine if conflicts can be resolved--the step after development of a DOE policy on

industry participation is to negotiate (probably informally) with carriers to resolve conflicts. At this point the DOE will know what the conflicts are and what it is prepared to do to resolve them. Bargaining will allow DOE to determine if conflict resolution is possible. Willingness to compromise is an important ingredient of successful bargaining. Different agreements might be struck with different carriers. Since this activity is to encourage industry participation (it is not part of procurement), no violation of procurement regulations need result.

- o Institute activities necessary to ensure negotiated industry participation--a final step to facilitate industry participation and one that is impossible to define in any detail at this point is to institute the activities agreed to in negotiations with carriers. Since a policy complete with an assessment of feasible alternatives was developed at an earlier stage, DOE should be capable of keeping its bargains. This is a vital step because the success and reputation of a party to political negotiation is dependent, in part, on keeping one's word.

The actions described illustrate the range of capabilities in addition to R&D, testing, and hardware development required to implement a transportation system. A more complete listing is found in Table A-1. Figure A-1 sequences the actions and shows where:

- DOE shares authority with another federal agency;
- DOE shares authority with non-federal actors; and
- Congressional approval is probably required.

Table A-1

(pg. 1 of 4)

INSTITUTIONAL FRAMEWORKTRANSPORTATION

Actors	Responsibilities	Status of Actions and Decisions	Points of Controversy	Needed Actions
DOT	<ul style="list-style-type: none"> Regulates safety in transport of hazardous material <ul style="list-style-type: none"> - routing - carriers - vehicles 	<ul style="list-style-type: none"> Safety regs in place Final Rule on Highway routing of RAM 	<ul style="list-style-type: none"> Routing of wastes by all modes Adequacy of enforcement of regs Adequacy of safety regs Very small staff 	<ul style="list-style-type: none"> Approve new vehicle hardware, other mechanical aspects of transportation system Implement highway routing rulemaking
		<ul style="list-style-type: none"> MOU between NRC and DOT in effect 	<ul style="list-style-type: none"> Effectiveness of interagency coordination Degree of authority over DOE 	<ul style="list-style-type: none"> Identify how waste transportation differs from RAM transport (Re)assess risk of HLW transportation
NRC	<ul style="list-style-type: none"> Regulates safety in transport of byproduct, source, and special nuclear material Regulates physical security of nuclear materials in transit 	<ul style="list-style-type: none"> FES on transportation; no further assessments planned Interim rule for physical security of spent fuel 	<ul style="list-style-type: none"> Adequacy of packaging regs How transportation will be factored into licensing Security requirements for TRU, HLW, spent fuel 	<ul style="list-style-type: none"> Establish acceptable risk from radwaste transportation Certify design of packaging for HLW, TRU, and spent fuel Complete rulemaking on physical security; expand to HLW, TRU Determine how transportation will be evaluated in repository licensing Develop capability to evaluate transport system
FEMA	<ul style="list-style-type: none"> Establishes Emergency Response Requirements outside facility boundaries 	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> Adequacy of emergency response capabilities Division of responsibility (Fed/State/Private) for emergency response 	<ul style="list-style-type: none"> Determine emergency response requirements for HLW, TRU, and spent fuel

Table A-1

(pg. 2 of 4)

Actors	Responsibilities	Status of Actions and Decisions	Points of Controversy	Needed Actions
ICC	<ul style="list-style-type: none"> Regulates economic aspects of interstate commerce 	<ul style="list-style-type: none"> Ruling which denies permission to require special trains or tariffs but which acknowledges DOT's & NRC's authority to grant permission if required for safety 	<ul style="list-style-type: none"> Special trains Special tariffs 	<ul style="list-style-type: none"> None
DOE	<ul style="list-style-type: none"> Overall responsibility for repository--option to act as own shipper, carrier, or both 	<ul style="list-style-type: none"> Established transportation technology center at Sandia Labs Developing transportation Program--Program specifics uncertain Testing program ongoing at Sandia 	<ul style="list-style-type: none"> How transportation will be factored into site selection Liability protection Use and availability of alternative modes of transport Availability of needed hardware Role of DOE as competitor/adversary of industry Emergency response capabilities 	<ul style="list-style-type: none"> Outline regulatory jurisdiction DOE falls within and determine how will act in areas not regulated (DOE) Establish in conjunction with NRC, industry, states, public, how transportation will be evaluated in site selection (DOE) Assess status of existing transport network Develop DOE policy on desired industry participation; assess obstacles to participation (DOE) Assess in conjunction with NRC, Shipper, carrier, state existing and alternative liability/financial protection options (DOE) Negotiate with potential carriers--determine if conflicts can be resolved Institute institutional/economic activities necessary to assure negotiated industry participation
TRANSPORTATION INDUSTRY	<ul style="list-style-type: none"> Normally responsible for design, construction, and operation of hardware systems for transport of commercial materials 	<ul style="list-style-type: none"> Awaiting actions of DOE, NRC, & DOT--reluctance to commit resources 		

Table A-1

(pg. 3 of 4)

Actors	Responsibilities	Status of Actions and Decisions	Points of Controversy	Needed Actions
DOE/TRANSPORTATION INDUSTRY (contd.)			<ul style="list-style-type: none"> ● Reluctance of Rails to act as carrier ● Trade offs of costs, efficiency, reliability, carrier availability 	<ul style="list-style-type: none"> ● Establish waste receiving criteria ● Decide whether hardware will be dual purpose or dedicated ● (DOE) Evaluate liability program in conjunction with NRC, industry, and states ● (DOE, INDUSTRY) Design construct, and test casks and hardware ● Identify feasible modes of transport together with container-vehicle concepts ● Perform feasibility, cost and overall risk studies on all modes ● Select mode(s) of transport ● (CARRIER) Select specific routes ● Determine how to meet physical security requirements ● (DOE, CARRIER) Institute required safeguards ● (DOE) Assess capabilities of state/local jurisdictions <ul style="list-style-type: none"> - to obstruct - to respond to emergencies - to perform regional planning

Table A-1

(pg. 4 of 4)

Actors	Responsibilities	Status of Actions and Decisions	Points of Controversy	Needed Actions
STATE/ LOCAL	<ul style="list-style-type: none"> • First line capability for emergency response • Maintains non-radiological standards for transport of hazardous material which rules are not inconsistent with DOT regulations 	<ul style="list-style-type: none"> • Proliferation of restrictive laws • Awaiting outcome of DOT highway routing rulemaking 	<ul style="list-style-type: none"> • Emergency preparedness • Appropriate role for states in all radwaste transportation decisions • Level of state involvement in enforcement 	<ul style="list-style-type: none"> • (DOE, STATES) Reach consensus on federal/state roles in emergency response • (DOE, STATES) Develop locale specific emergency response program • (DOE, STATE) Institute locale specific emergency response planning and training • Reach consensus with state on road/rail improvements, inspection, road/rail maintenance, and so on • Build or approve rail spur lines over non-federal land • Make or approve necessary road improvements

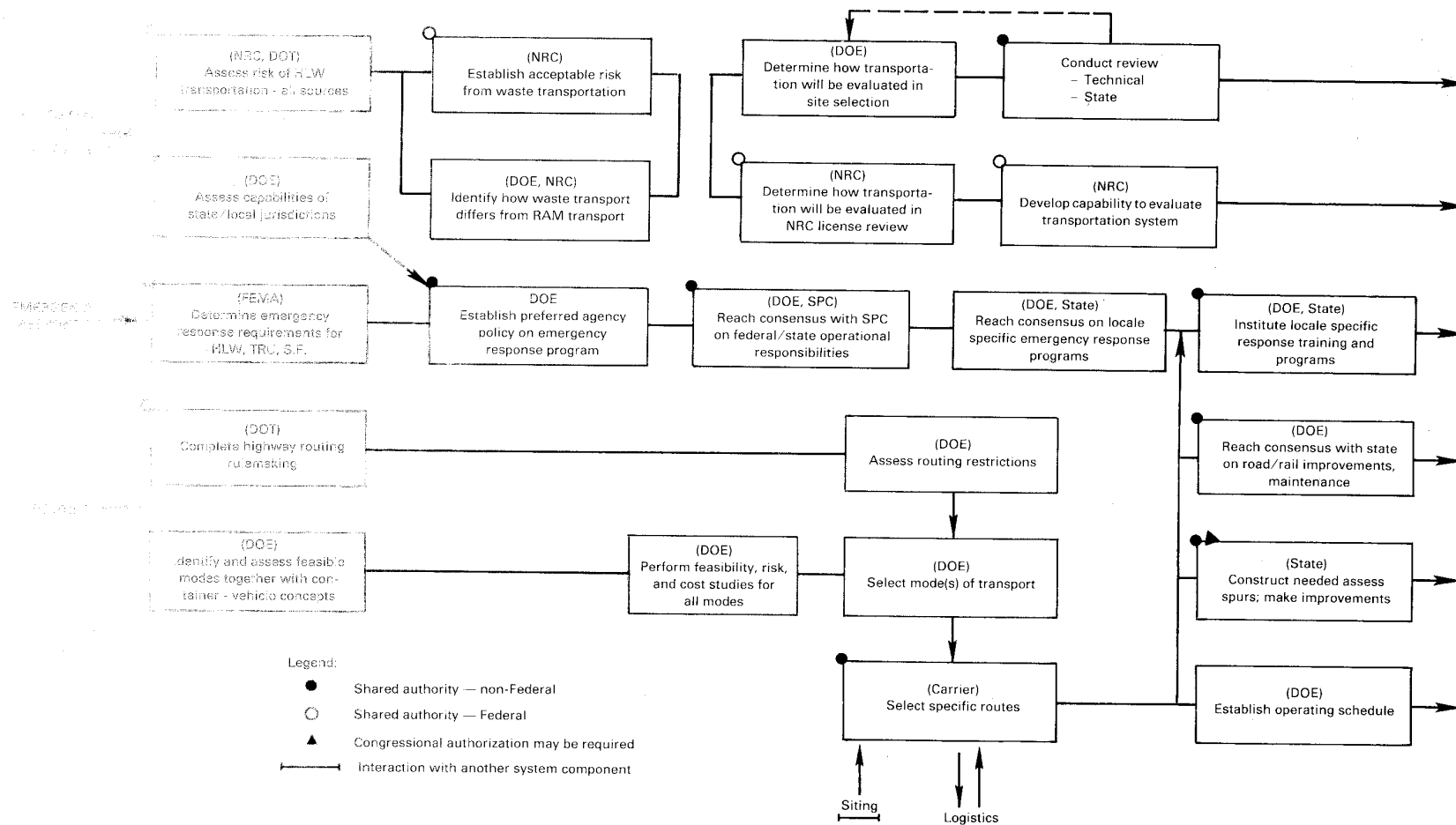


Figure A-1 -- Path of Needed Actions--Transportation

APPENDIX B

INSTITUTIONAL CONSIDERATIONS FOR REMAINING HLW DISPOSAL SYSTEM COMPONENTS

The institutional framework was evaluated and paths of needed actions identified for the remaining HLW system components in the same manner as described in Section II. These components are:

- repository design and construction,
- waste package,
- radiologic monitoring,
- financing, and
- operation/administration/personnel.

For each component there is a table which arrays needed actions by actor and a path of needed actions which highlights points of shared authority. These tables and figures represent a preliminary evaluation; they are intended to serve as a basis for more intensive planning and analysis by DOE.

INSTITUTIONAL FRAMEWORK
REPOSITORY DESIGN AND CONSTRUCTION

Actors	Responsibilities	Status of Actions and Decisions	Points of Controversy	Needed Actions
NRC	<ul style="list-style-type: none"> ● Licensing authority <ul style="list-style-type: none"> - design and performance criteria - construction authorization 	<ul style="list-style-type: none"> ● Regulatory development ongoing ● Proposed procedural rule published ● Advance notice of proposed technical rule published 5-13-80 ● Hindered by lack of EPA standards ● Developing license review capability 	<ul style="list-style-type: none"> ● Technical support and justification for regulation ● Ability to license against criteria ● Performance v. specific criteria ● Dividing line between site characterization at-depth and construction ● Timing of implementation of NRC regulatory oversight ● Retrievability of waste (e.g., time frame) ● Disposal v. storage of spent fuel ● Detail of decommissioning and repository closure plans ● Number of repositories ● Size of repository ● Availability of financial and technical assistance to states ● Meaning of state consultation and concurrence in design and construction activities 	<ul style="list-style-type: none"> ● Issue proposed performance criteria <ul style="list-style-type: none"> - determine retrieval capabilities of facility; component v. system performance; design criteria ● Conduct rulemaking ● Conduct construction authorization review ● Complete generic design specifications ● Decide what wastes are to be disposed of in the facility ● Prepare site-specific calculational models of repository performance ● Determine Permitting Authority of States (e.g., air and water quality, land use) ● (DOE, STATE) Reach consensus on consultation and concurrence ● Reach consensus on technical and financial assistance to state for review of design activities ● Develop QA program ● Develop preliminary decommissioning and repository closure plan ● Develop plans for retrieval and alternate storage of wastes should it be required ● Determine retrieval capabilities of the facility--design accordingly ● Develop test facilities ● Testing of engineering systems ● Systems acquisition for facility design
DOE	<ul style="list-style-type: none"> ● Responsible for design and construction of HLW repositories 	<ul style="list-style-type: none"> ● Conceptual designs in salt prepared ● Generic calculational models of repository performance being developed 		

Table B-1

(pg. 2 of 2)

Actors	Responsibilities	Status of Actions and Decisions	Points of Controversy	Needed Actions
				<ul style="list-style-type: none"> • Prepare application to NRC for construction authorization • Apply for other required permits--land use for secondary structures, etc. • Determine contracting procedure and contract evaluation and selection criteria • Facility system acquisition
INDUSTRY-- AE and Construc- tion	N/A	• None		<ul style="list-style-type: none"> • Design repository under contract to DOE • Construct repository under contract to DOE
STATES	• "Consultation and concurrence"	• None	<ul style="list-style-type: none"> • Capability to judge adequacy of design and construction • (See above under DOE) 	(See above under DOE)

Table B-2

INSTITUTIONAL FRAMEWORK
WASTE PACKAGE AND WASTE TREATMENT

Actors	Responsibilities	Status of Actions and Decisions	Points of Controversy	Needed Actions
NRC	<ul style="list-style-type: none"> • Licensing authority* - waste form/package performance 	<ul style="list-style-type: none"> • Regulatory development ongoing • Proposed criterion requiring 1000 year integrity • Advance notice of proposed rule published 5-13-80 	<ul style="list-style-type: none"> • Acceptability of criteria • Ability to license against 1000 year criterion 	<ul style="list-style-type: none"> • Issue proposed performance criteria--role of waste form in repository performance • Conduct rulemaking • Conduct review for repository construction authorization--confirm DOE model of waste form performance
DOE	<ul style="list-style-type: none"> • Responsible for development and operation of repository--will take possession and title to all waste disposed 	<ul style="list-style-type: none"> • Ongoing R&D on waste immobilization and waste package--candidate forms include concrete, cements, metal matrices, glasses and ceramics • Work on glass farthest developed • Have "demonstrated" vitrification of HLW at Hanford--no further work planned on demonstration of solidification • Work ongoing re: spent fuel over-packages 	<ul style="list-style-type: none"> • Final NRC criteria will follow proposed criteria by a year or more--DOE risks following guidelines which will change • Concurrent R&D and regulatory development may create discontinuities between what is required and that available • The role waste form will play in overall repository performance • Ability to demonstrate compliance with NRC performance criteria • Compatibility with transport hardware 	<ul style="list-style-type: none"> • Establish, with technical and state review, role of waste package in repository performance; in transportation • Identify and evaluate potential waste forms/package combinations • Assess state-of-the-art for immobilization and packaging • Develop analytical models of waste package performance as part of repository system • Conduct R&D on waste forms and packaging--laboratory and in situ testing • Choose technologies to bring to demonstration phase • Site demonstration facilities • Build and operate demonstration facilities (congressional authorization) • Choose final treatment methods/waste package • Site full-scale facilities • Build and operate full-scale facilities (congressional authorization)

* NRC will regulate DOE waste treatment activities only if they occur on site at a regulated facility such as on site at the repository.

Table B-3

INSTITUTIONAL FRAMEWORK

RADIOLOGIC MONITORING

Actors	Responsibilities	Status of Actions and Decisions	Points of Controversy	Needed Actions
EPA	<ul style="list-style-type: none"> Establishes generally applicable environmental standards 	<ul style="list-style-type: none"> Regulatory development in progress Proposed standards scheduled for Spring, 1980 		<ul style="list-style-type: none"> Issue final HLW standards
NRC	<ul style="list-style-type: none"> Licensing authority-- requirements for monitoring 	<ul style="list-style-type: none"> Regulatory development in progress Advance notice of proposed regulations published 5-13-80 	<ul style="list-style-type: none"> Need for monitoring independent of DOE activities 	<ul style="list-style-type: none"> Determine need for monitoring Conduct rulemaking Conduct construction authorization review Issue license
DOE	<ul style="list-style-type: none"> Perform monitoring considered necessary to assess repository integrity Perform monitoring required by NRC regulations 	<ul style="list-style-type: none"> Unknown (found no references in program materials) 	<ul style="list-style-type: none"> Type of information needed which can only be gained through monitoring Identification of release pathways Time period(s) for which monitoring is required Ability to monitor without compromising the integrity of the repository Availability of instrumentation to measure extremely small radiologic changes 	<ul style="list-style-type: none"> Assess state of the art capabilities to perform monitoring Identify release pathways Assess need for monitoring to <ul style="list-style-type: none"> confirm repository performance warn of the need for contingency action modify prediction models Develop monitoring capability Institute program
STATES	<ul style="list-style-type: none"> "Consultation and concurrence"-- some states have indicated a desire to conduct monitoring consistent with responsibilities for public health and safety 	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> Appropriateness of state v. NRC monitoring financial and technical assistance to perform monitoring 	<ul style="list-style-type: none"> (DOE, STATE) Reach consensus on role of state in monitoring and on adequacy of DOE program Reach consensus with host state on site specific monitoring program

INSTITUTIONAL FRAMEWORKFINANCING

Actors	Responsibilities	Status of Actions and Decisions	Points of Controversy	Needed Actions
DOE	<ul style="list-style-type: none"> • Responsible for assuring equitable financing and financial protection for repository operations 	<ul style="list-style-type: none"> • Published several cost bases for HLW disposal • Public statements that Price-Anderson coverage is adequate • No further action on liability questions 	<ul style="list-style-type: none"> • Ability to allocate costs of system (commercial, defense) • Nature of fee arrangements <ul style="list-style-type: none"> - when paid - valuation of spent fuel - when title is transferred • Funding arrangements <ul style="list-style-type: none"> - ability to get congressional authorization - difficulties with revolving fund • Nature and extent of third-party liability protection • Applicability of Price-Anderson • Potential for subsidy to nuclear industry • Use of Federal Funds for impact compensation and/or financial incentives 	<ul style="list-style-type: none"> • Develop DOE Preferred Policy on transfer of title to and possession of material • Identify cost requirements of HLW repository system <ul style="list-style-type: none"> - R&D costs - capital costs - management costs - operating/monitoring costs - payments to state/local - regulatory fees • Identify need for and means of providing contingency funds (short term and long term) • Identify and evaluate fiscal mechanisms that could be made available to meet each of these costs over the short and long terms • Evaluate how fiscal mechanisms can determine allocation of costs to users of the system (commercial, defense) • Identify mechanisms to recapture costs to defense and commercial users of the system • Establish fee schedule • Arrange financing • Establish, in conjunction with utilities, timing and procedures for transfer of title and material • Investigate current mechanisms and responsibilities for financial protection (liability)

Table B-4

(pg. 2 of 2)

Actors	Responsibilities	Status of Actions and Decisions	Points of Controversy	Needed Actions
DOE (contd.)				<ul style="list-style-type: none"> • Identify and evaluate potential alternative mechanisms • Establish liability program, if appropriate
STATES/ SPC	<ul style="list-style-type: none"> • "Consultation and concurrence" 	<ul style="list-style-type: none"> • None 	<ul style="list-style-type: none"> • Liability protection • Equity--balance of costs and benefits • Valuation of fuel in utility rate bases 	<ul style="list-style-type: none"> • Reach consensus with SPC on nature of third-party liability protection • Reach consensus with state on nature and method of any payments • PUC action on valuation of fuel and charges in rate base
NRC	<ul style="list-style-type: none"> • License Repository 	<ul style="list-style-type: none"> • None 	<ul style="list-style-type: none"> • Price-Anderson applicability and other liability requirements 	<ul style="list-style-type: none"> • Establish license fees
INDUSTRY/ ELECTRIC UTILITIES	<ul style="list-style-type: none"> • Spent fuel management until transfer of ownership • Adequate recompense for fuel 	<ul style="list-style-type: none"> • Unknown 	<ul style="list-style-type: none"> • Valuation of fuel in rate base • Cost of waste disposal • Need to establish reserves or contingency funds for anticipated costs • Liability protection 	<ul style="list-style-type: none"> • Interaction with DOE to resolve differences or lobbying in Congress and before states

INSTITUTIONAL FRAMEWORK
OPERATIONAL, ADMINISTRATIVE AND PERSONAL

Actors	Responsibilities	Status of Actions and Decisions	Points of Controversy	Needed Actions
NRC	<ul style="list-style-type: none"> ● Licensing authority <ul style="list-style-type: none"> - safeguards - emergency response - administrative/organizational 	<ul style="list-style-type: none"> ● Proposed procedural rule: requires DOE certification that it will institute safeguards equivalent to that provided at "comparable" DOE surface facilities ● Requires preparation of a material control and accountability plan, personnel, administrative and organizational plans 	<ul style="list-style-type: none"> ● Identification of existing facilities which are comparable to a repository (re: safeguards) ● Assuring system reliability--safety systems, backups, etc. ● Assuring system reliability--human error ● Training programs ● Operator/personnel qualifications ● Centralized v. decentralized DOE management structure 	<ul style="list-style-type: none"> ● Determine extent of licensing authority and involvement ● Determine requirements for physical security ● Determine requirements for material control ● Conduct rulemaking ● Conduct construction authorization review ● Conduct license review ● Inspect against license
DOE	<ul style="list-style-type: none"> ● Responsible for the safe and reliable operation and safeguarding of a repository 	<ul style="list-style-type: none"> ● Unknown 	<ul style="list-style-type: none"> ● Organizational structure appropriate for repository operation ● Extent and enforcement of land use controls ● Emergency response planning ● Procedures for coping with radiologic emergencies ● Scheduling 	<ul style="list-style-type: none"> ● Evaluate decentralization of DOE organization ● Establish responsibility within DOE for all needed repository activities (including those exercised by actors outside DOE) ● Identify and assess organizational alternatives for repository operation ● Assess system reliability <ul style="list-style-type: none"> - error detection and correction - reliability of workers

Table B-5

(pg. 2 of 3)

Actors	Responsibilities	Status of Actions and Decisions	Points of Controversy	Needed Actions
DOE (cont.)				<ul style="list-style-type: none"> - identification of tasks in system vulnerable to operator or monitor error and consequences of error - worker environments, hiring, incentives, etc. which can affect worker performance - system designs which reduce the number of places where worker performance is critical • Determine policy for land ownership and controls • Identify existing state restrictions and permitting requirements were facility non-federal; conform where possible, give cause for non-conformance • Assess alternatives for land use controls and enforcement • Prepare plans for land acquisition and control • Investigate means to ensure operator accountability over the long term • Establish personnel qualifications • Establish training program • Assign, hire or contract for operators • Assess need and alternative arrangements for emergency response--on site and off site

(pg. 3 of 3)

Table B-5

Actors	Responsibilities	Status of Actions and Decisions	Points of Controversy	Needed Actions
DOE (contd.)				<ul style="list-style-type: none"> • Develop schedules <ul style="list-style-type: none"> - construction - training - operational - receipt of waste - emplacement of waste - maintenance • Develop program of occupational radiation exposure monitoring • Develop material control, physical security, and contingency plans • Determine testing and ongoing R&D requirements • Develop testing capability
STATES	<ul style="list-style-type: none"> • "Consultation and concurrence" 	<ul style="list-style-type: none"> • None 	<ul style="list-style-type: none"> • Human and system reliability • Emergency response planning • Adequate safeguards • Land use controls 	<ul style="list-style-type: none"> • Reach consensus on state consultative role and adequacy of emergency response and protection programs • Reach consensus on land use controls

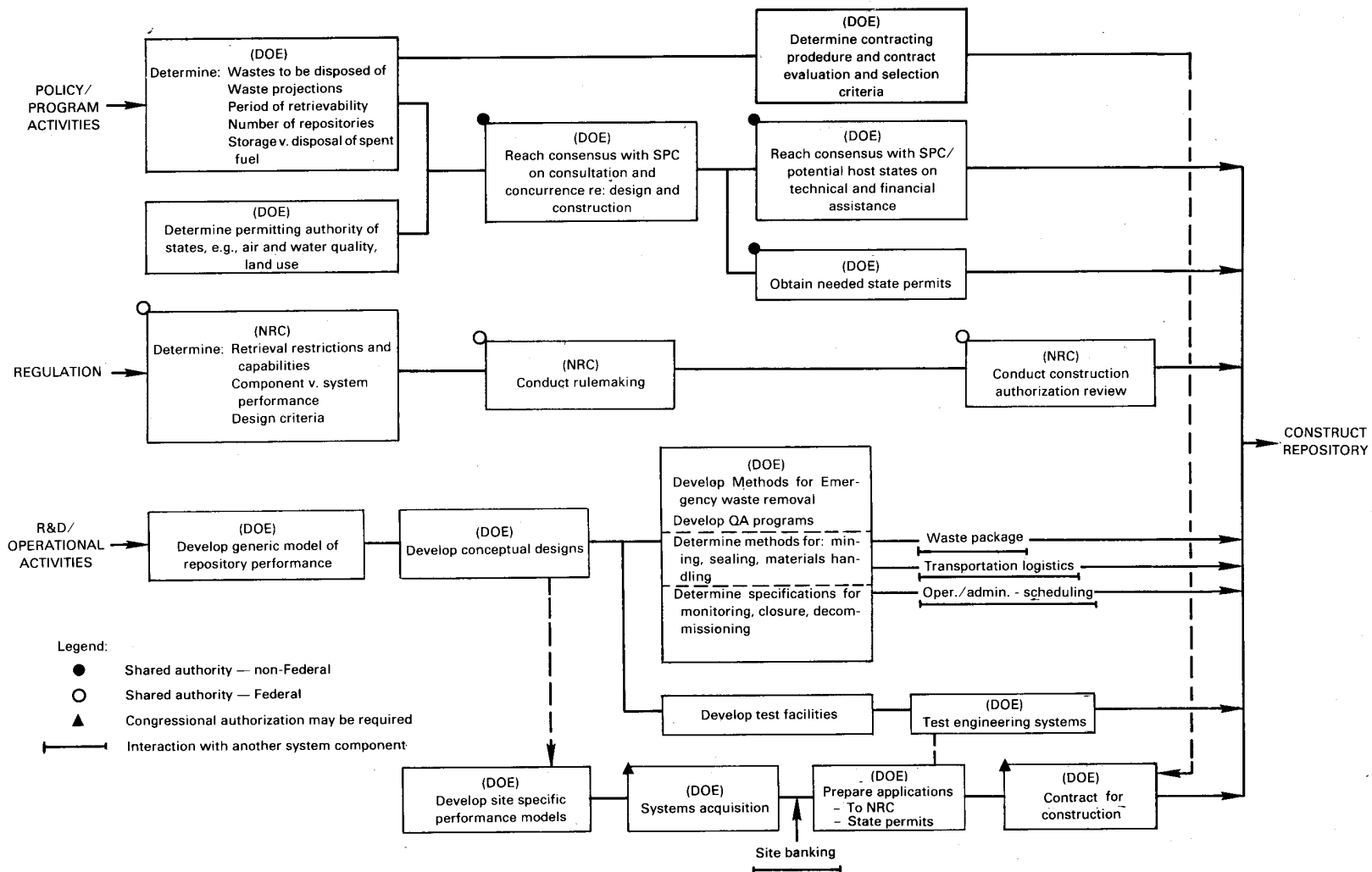


Figure B-1--Path of Needed Actions--Repository Design and Construction

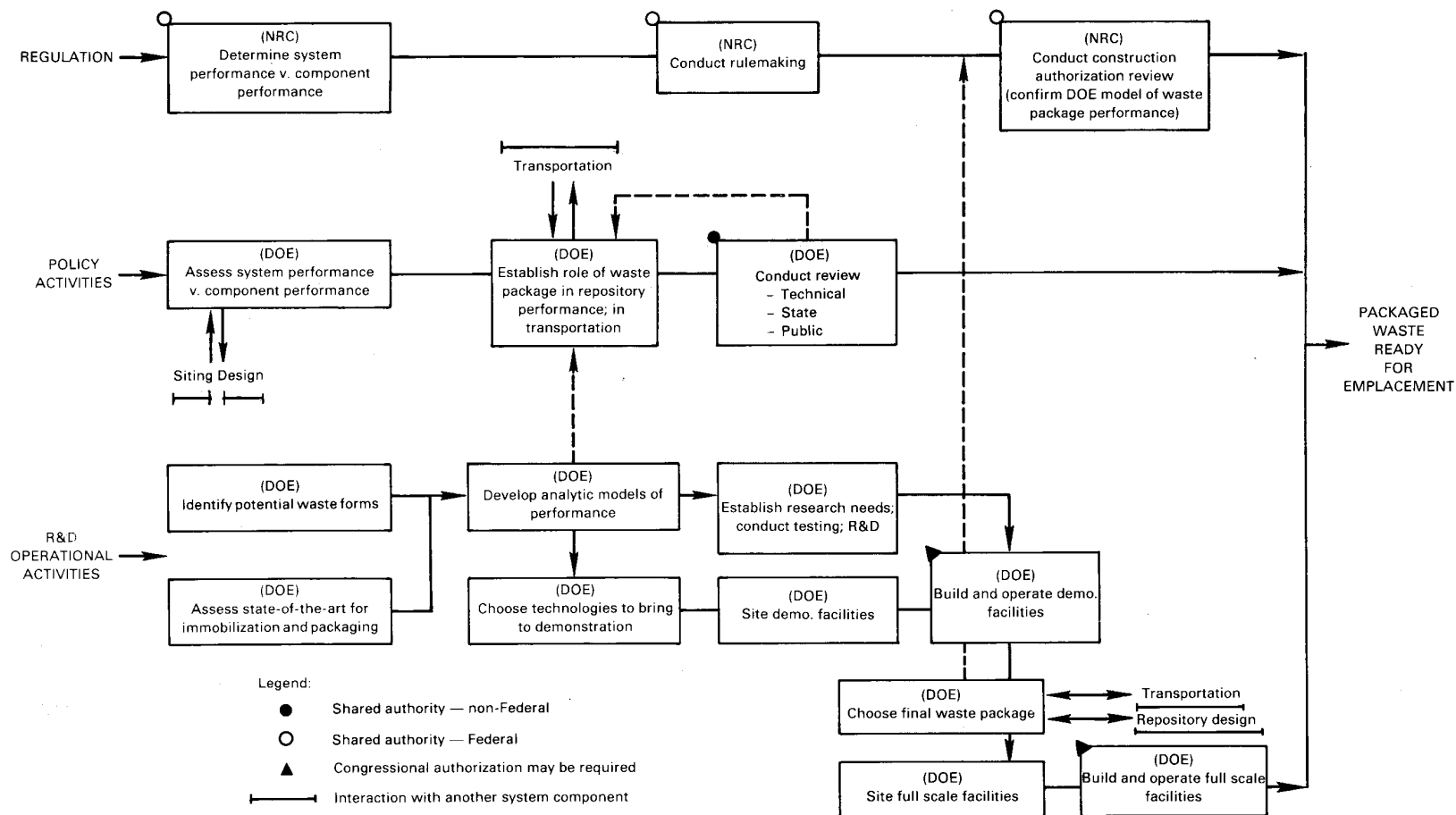


Figure B-2--Path of Needed Actions--Waste Package and Waste Package Treatment



Figure B-3--Path of Needed Actions--Radiologic Monitoring

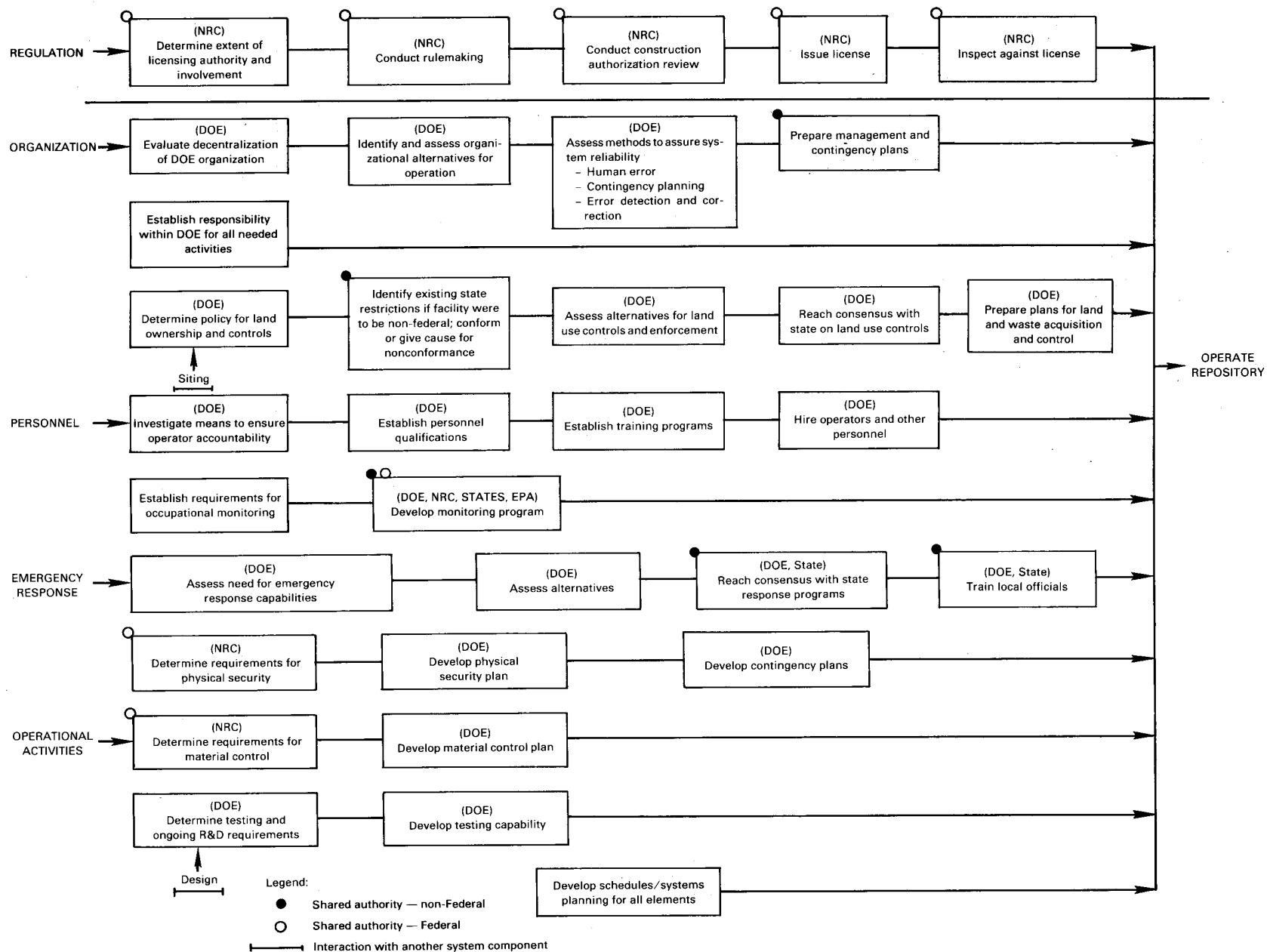


Figure B-5--Path of Needed Actions--Operation/Administration/Personnel

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